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Children's development at the start of school in Scotland and the progress made during their first school year: An analysis of PIPS baseline and follow-up assessment data



CHILDREN, EDUCATION AND SKILLS

Children's development at the start of school in Scotland and the progress made during their first school year:

An analysis of PIPS baseline and follow-up assessment data

A research report for the Scottish Government

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Contents

Contents	2
1. Executive summary.....	5
1.1 Background to the report	5
1.2 The PIPS on-entry baseline and follow-up assessment.....	5
1.3 Sample.....	5
1.4 Key findings from the analysis	5
1.4.1 Start of Primary 1	5
1.4.2 Progress to the End of Primary 1	7
1.5 Conclusions	8
2. Introduction.....	9
2.1 Background to the PIPS on-entry baseline and follow-up assessment and its use in Scotland	9
2.2 The scope and structure of the report	10
3. Establishing a representative sample of PIPS data for Scotland and a stable sample of schools in Scotland for trend analysis.....	11
3.1 Characteristics of the 2012/13 sample	11
3.1.1 Sample size	11
3.1.2 Home background (deprivation index).....	11
3.1.3 Age	12
3.1.4 Gender	13
3.1.5 Pre-school experience	13
3.1.6 English as an Additional Language	13
3.2 Characteristics of the data sets for Primary 1 2012/13, 2013/14, 2014/15 trends over time analyses.....	14
3.2.1 Trends over time.....	14
4. Children's development at the start of Primary 1 and progress to the end of academic year 2012/13.....	15
4.1 The content of the PIPS assessment	15
4.2 Item maps at the start of Primary 1	17
4.2.1 The full PIPS cognitive development scale	17
4.2.2 Early mathematics	18
4.2.3 Early reading.....	18
4.2.4 Picture vocabulary	19
4.2.5 Phonological awareness.....	19

4.3 Differences between groups on the cognitive measures at the start of Primary 1	19
4.3.1 Age	20
4.3.2 Gender	20
4.3.3 Deprivation	21
4.3.3.1 Are boys or girls particularly affected by deprivation?	23
4.4 Levels of personal and social development (PSD): differences between groups	24
4.4.1 Age	25
4.4.2 Gender and deprivation	25
4.5 Progress in cognitive development and PSD in Primary 1	26
4.5.1 Cognitive development	26
4.5.2 Differences between groups	27
4.5.2.1 Age, gender and deprivation	27
4.5.2.2 Deprivation	28
4.6 Personal and social development	30
4.6.1 Differences between groups	30
5. Comparisons with England	32
5.1 Representativeness and size of the sample	32
5.2 On entry to school	32
5.2.1 Early mathematics	32
5.2.2 Early reading	32
5.2.3 Personal and social development	33
5.3 Progress	33
5.3.1 Early mathematics	33
5.3.2 Early reading	33
5.3.3 Personal and social development	33
6. Trends over time for 2012/13, 2013/14 and 2014/15	34
6.1 Age on entry	34
6.2 Start of Primary 1	34
6.2.1 Cognitive development	34
6.2.2 Cognitive measures with age, gender and deprivation	35
6.3 Progress during Primary 1	36
6.4 Personal and social development	37
6.4.1 Start of Primary 1	37
6.4.1.1 Age, gender and deprivation	38

References	40
Appendix A.....	42
Description of method to establish a representative sample of PIPS data for Scotland and a stable cohort for trend analysis.....	42
Representativeness of the 2012/13 Scottish cohort	42
Appendix B.....	44
Personal and social development scales	44
Adjustment – Comfortable	44
Adjustment – Independence	44
Personal – Confidence	45
Personal – Concentration (Self-directed activities).....	45
Personal – Concentration (Teacher-directed activities).....	45
Personal – Actions.....	45
Social – Relationships with peers	46
Social – Relationships with adults	46
Social – Rules.....	47
Social – Cultural awareness	47
Social – Communication.....	47
Appendix C.....	47
Item maps at the start of Primary 1	48
Appendix D.....	53
Supplementary information.....	53
Appendix E	54
Characteristics of children who are old for Primary 1	54
PSD for older children.....	55
Appendix F	57
Does the link between deprivation and progress vary across schools or are some schools better at improving equity?	57

1. Executive summary

1.1 Background to the report

There is wide recognition that children's development and experience in their early years, and progress during the first year of school, are crucial for success in later life. It is important to assess children during this early period to monitor their development so that educational provision can be tailored to their needs. This report describes a secondary analysis of existing data from the Performance Indicators in Primary Schools (PIPS) On-entry Baseline and Follow-up assessment, which is widely used by schools in Scotland for such formative purposes. This secondary data analysis offers a perspective for policy-makers by providing a picture of children's development when they start school in Scotland and progress during their first year at school. Trends over time and a comparison of the development of children starting school in Scotland and England are also reported.

1.2 The PIPS On-entry Baseline and Follow-up Assessment

The PIPS On-entry Baseline and Follow-up assessment is a measure of children's developing abilities at the start of school and their progress during their first school year. It assesses cognitive development (vocabulary acquisition, phonological awareness, early reading, and early mathematics) and personal and social development. The assessment of cognitive development takes place at the start of Primary 1 by a teacher working through a series of questions with each child on a one-to-one basis. Teachers rate each child's personal and social development on the basis of their observations collected over the first few weeks of the school year. Both assessments are repeated at the end of Primary 1.

1.3 Sample

Data were analysed from three academic years: 2012/13, 2013/14 and 2014/15. Nationally representative samples of pupils were drawn from the full datasets for each school year. The sample for each year included around 6,500 children. The average age of children at the start of school was five years although a high proportion of older children was noted, reflecting the practice of some parents to defer the entry of their child for one year if they were the youngest in the cohort.

1.4 Key findings from the analysis

1.4.1 Start of Primary 1

At the start of Primary 1, children were typically able to point to objects such as a microscope, jewellery and a saxophone from picture scenes. They could identify several letters and single digits, and answer early mathematics questions such as 'here are six ice creams, if I took three away, how many would be left?'.

The analysis found a general trend for older children achieving higher scores than younger ones although the correlations between age and development were weak. The sample included a small proportion of older children whose entry to school had been deferred by a year. Analysis revealed that these children were likely to have had delayed development and this may have contributed to decisions to defer entry to school for a year. They had, on average, lower scores on the assessment of cognitive development than would be expected for their age. They also had lower ratings of personal and social development.

Girls were ahead of boys in their vocabulary acquisition, phonological awareness and early reading by up to the equivalent of five months of development. Their early mathematics scores were not significantly different from those of the boys. The boys' spread of scores was wider than the girls' for all areas, meaning that proportionately there were more boys with very high and very low scores.

Children from the least deprived areas had higher scores than those from the most deprived areas by around 14 months of development, although the most able quarter of the most deprived group were ahead of the least able quarter of the most affluent group. No evidence was found to indicate that the gender difference was related to deprivation.

The strongest areas of personal and social development for all children were adjustment to the school setting, independence, relationships with peers, the awareness of the need to follow rules and communication. Their cultural awareness was relatively weaker at this stage. Girls' scores were significantly higher than boys' with the greatest differences being in concentration and actions. The scores of children from the least deprived areas were significantly higher than those of children from the most deprived areas on several of the scales, with the largest differences being seen in their adjustment to the school setting, concentration on teacher-directed activities and cultural awareness.

Children in Scotland had higher scores across early reading, early mathematics as well as personal and social development at the start of school compared with England. This is partially explained, but not fully, by maturation, since they start school, on average, six months older than their English peers. An interesting difference was seen for early reading, with the distribution of scores for Scottish children having less of a spread compared with England; there was a smaller difference between children with very high and very low scores in Scotland compared with England. It appeared that children in Scotland were beginning to learn to read in a way that reflected systematic teaching. For example, they were typically able to identify many more letters at the start of school than children in England, and this may be a reflection of the focus of pre-school provision.

Over the three year period between 2012/13 and 2014/15, children's development at the start of school was quite stable although there was a gradual slight decline in their scores. This corresponded to a slight change in demographics with an increasing number of young children in Primary 1 for whom English was an additional language, which may have been a contributory factor. Children's personal and social development remained stable over time.

1.4.2 Progress to the End of Primary 1

An educationally significant and impressive amount of progress was made during Primary 1. By the end of the year, children were typically able to decode several high-frequency words and understand their meaning, and in mathematics they could perform calculations and solve a variety of problems. The gains were also statistically significant. When plotted on the same scale, the children who were on the 50th percentile¹ at the start of the year moved to the 95th percentile by the end of Primary 1. They made many more months of progress in school than would be expected from natural maturation. From the rate of progress² seen in Primary 1, it is estimated that if children did not go to school, it would take them more than four years before they were able to read at the same level, and three years to perform at the same level in mathematics starting from the point where they would have entered school. School really does make a difference.

Although statistically significant differences in progress were seen between boys and girls for early reading and early mathematics, these were very small. Girls made more progress than boys in early reading but the reverse held for early mathematics.

Children from the least deprived areas made more progress than those in the most deprived areas for early reading and picture vocabulary where, perhaps, they were receiving more enriched support in their homes. But for early mathematics, the children in the most deprived areas made more progress and caught up a little with their more affluent peers.

Progress varied from school to school by a substantial amount: 12 months of improvement in reading and 14 months for mathematics.

Progress during the year was seen for all areas of personal and social development, and particularly large gains were seen in children's cultural awareness.

Over the three year period between 2012/13 and 2014/15, the end of year scores dropped slightly but generally not as much as the scores at the start of Primary 1. This was because children were actually making more progress in Primary 1 in later years; this was most noticeable in mathematics.

Children's progress in personal, social and emotional development over the course of Primary 1 remained stable across the three years which were analysed.

¹ A percentile indicates the percentage of children whose scores fall below a given value. Children whose scores were on the 50th percentile at the start of Primary 1 were in the middle of the range: the median. If we look at the progress that they made over this year, their development increased to the equivalent of children who started school at the very top of the range (the 95th percentile).

² A regression of attainment against age at the start of Primary 1 indicated how much growth there was in attainment for every month of maturation. This was used to produce measures of months of change.

1.5 Conclusions

This secondary analysis of existing data from the Performance Indicators in Primary Schools (PIPS) On-entry Baseline and Follow-up assessment shows the substantial educational and statistically significant progress made by children in Scotland during their first year of school. The weak links to deprivation, age and gender suggest that these factors are not deterministic in the progress made during Primary 1. Schools made a major difference and the amount of progress which pupils make in different schools varies by around twelve months. Children from the most deprived backgrounds made relatively less progress in early reading than those from the most affluent backgrounds and they made more progress in early mathematics.

Children's cognitive, personal and social development was at a higher level than their English peers at the start of school. They were on average six months older but this did not explain all of the advantage. It may be a reflection of different values and culture in the home environment and the focus of pre-school provision in Scotland.

2. Introduction

There is wide recognition that children's development and experience in their early years are crucial for success in later life. Their progress during the first year at school has also been shown to have long term consequences (Tymms, Jones et al., 2009). The process of development is not determined by nature or nurture alone but rather by an interaction between the two (Shonkoff and Phillips, 2000; Rutter 2006). Environmental influences start at conception and a growing body of research identifies the first 1,000 days as being crucial (Black and Hurley 2014); influences which can be tackled through policy initiatives. Development in the first five years of life lays the foundations for lifelong development (Shonkoff and Phillips, 2001) and therefore, Fernald et al., (2009) suggested that "it is critical to assess children during this vulnerable period to determine if they are developing appropriately and develop interventions if children are not developing properly". Policy makers, researchers and educationalists are interested in young children's development from a variety of perspectives but a general theme which brings them together is the desire to improve children's later outcomes. This report describes a secondary analysis of existing data from the Performance Indicators in Primary Schools (PIPS) On-entry Baseline and Follow-up assessment. It offers a perspective for policy-makers by providing a picture of children's development when they start school in Scotland, progress during their first year at school, differences between children by age, sex and deprivation area, trends over time and a comparison of the development of children starting school in Scotland with children starting school in England.

2.1 Background to the PIPS on-entry baseline and follow-up assessment and its use in Scotland

The PIPS On-entry Baseline and Follow-up assessment is an assessment of children's developing abilities at the start of school and their progress during their first school year. It was first developed in 1994 (Tymms, 1999a and 1999b) with the aim of providing teachers with good quality information about their new intake at the start of school for formative purposes, and with a baseline from which progress can be monitored (Tymms and Albone, 2002). It takes a unique approach to assessment (Merrell and Tymms, in press) dealing with a number of difficult issues associated with work in this age range.

The assessment has been used extensively in Scotland with children at the start and end of Primary 1. Schools in Scotland have, up to now, opted to use the assessment predominantly with the support of their Education Authority and there is generally an agreement to share the data between school and authority. The data continue to be used formatively by teachers and for self-evaluation purposes by schools and authorities. A key feature of the PIPS monitoring system is that data which enable the identification of individual pupils, schools and education authorities are not made public and are not used for accountability. Upon registering to use PIPS, schools consent to their data being used on an anonymous basis for research purposes such as the present report.

2.2 The scope and structure of the report

The report begins by providing a detailed picture of children's development at the start of school in Scotland with respect to their early reading, picture vocabulary, phonological awareness, early mathematics, personal and social development.

The relationships between the areas of development outlined above and key background variables (gender, age and deprivation) are also presented.

The progress made by children in each of the areas outlined above during their time in Primary 1 is then explored by analysing data collected from the PIPS On-entry Baseline Assessment and Follow-up. This progress is also analysed against background variables (gender, age, deprivation and school attended).

The data from Scotland are then compared with children in Reception classes in England. Many schools in England use the PIPS Baseline and Follow-up Assessment at the start and end of the Reception year of primary school. The content of the assessment is the same as in Scotland although the sound files are different to accommodate different accents. Comparisons of children's development at the start of school and the progress which they make during their first year are thus possible.

Trends over time in Scotland are examined using data from three full academic years: 2012/13, 2013/14 and 2014/15. A particular focus is given to equity during this period and whether the link between progress and deprivation has been changing.

3. Establishing a representative sample of PIPS data for Scotland and a stable sample of schools in Scotland for trend analysis

Data were analysed from three cohorts of pupils in Scotland; those children in Primary 1 during the 2012/13, 2013/14 and 2014/15 academic years. The 2012/13 cohort was analysed in most detail. This particular cohort has previously been analysed and its representativeness established (Tymms et al., 2014). The procedures are described in the Tymms et al. (2014) research report but for the reader's ease, they are also described in Appendix A of this report.

For the trend analysis, the same sampling process was used for the 2013/14 and 2014/15 data as was used for the 2012/13 data. The Scottish Index of Multiple Deprivation (SIMD) deciles and the percentage of boys/girls were used to establish samples that were representative of Scotland and so were comparable across the three years. Data were excluded if an assessment date was missing or was unrealistic, if the intake was recorded as Term 2 or 3, or if one or both total scores were missing.

Exactly the same numbers of pupils were taken in each decile as were used in the 2012/13 sample.

3.1 Characteristics of the 2012/13 sample

3.1.1 Sample size

A total of 6,627 children were included in the Scottish sample for the 2012/13 academic year. These children all had start of Primary 1 data for the cognitive development part of the assessment. The assessment of personal and social development was optional and not all children were assessed at the start and end of the year. The numbers in the sample are detailed in Figure 1.

Figure 1: Numbers of pupils in Scottish sample in the 2012/13 academic year

	Cognitive development	Personal & Social development
Start of Primary 1	6,627	669
End of Primary 1	6,626	396

3.1.2 Home background (Scottish Index of Multiple Deprivation)

The proportion of pupils in each SIMD decile nationally in Primary 1 is mirrored in the sample for the 2012/13 cohort as Figure 2 shows.

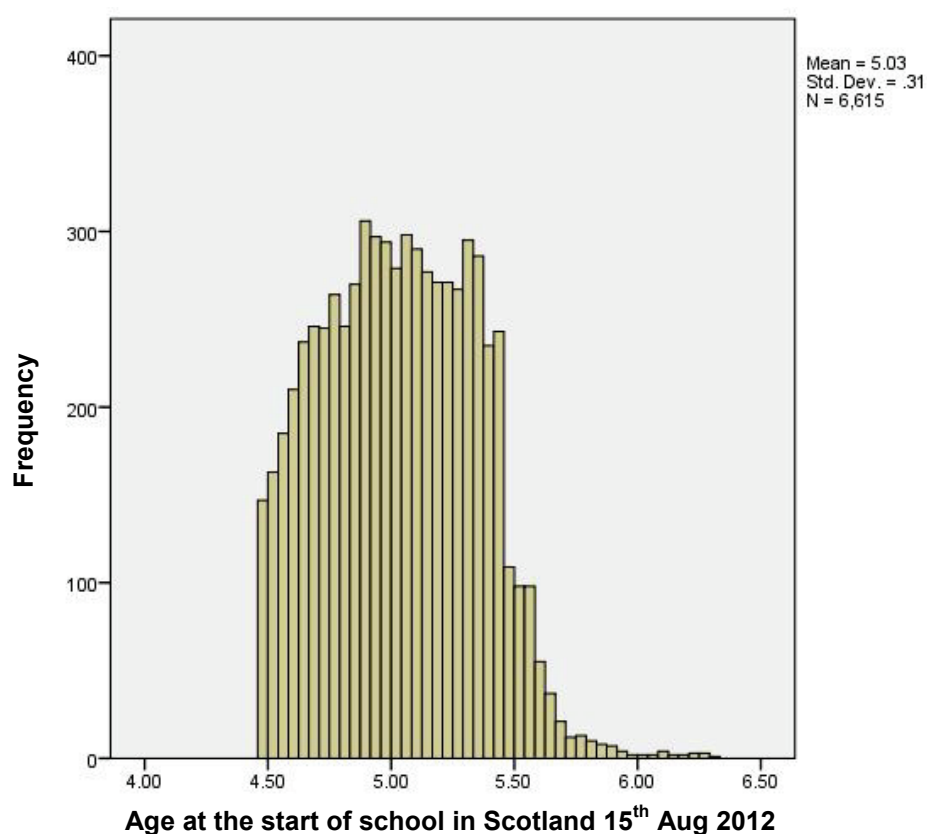
Figure 2: Numbers of pupils in Scottish sample in the 2012/13 academic year by decile

Decile	1	2	3	4	5	6	7	8	9	10	Total
Number in sample	788	722	656	656	656	656	656	656	656	525	6,627
Proportion in sample	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08	
Number in P1 2012	6,841	6,146	5,568	5,593	5,456	5,417	5,736	5,567	5,440	4,585	56,349
Proportion in P1 2012	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08	

3.1.3 Age

The age of children starting school in Scotland is shown in Figure 3.

Figure 3: The distribution of ages of pupils in Scottish sample in the 2012/13 academic year



The 2012/13 data set contained dates of birth for 6,615 pupils which enabled us to calculate their age at the start of school. The mean age of the pupils starting school in Scotland was 5.03 years. Figure 3 illustrates the spread of ages at the start of school and it is evident that a number of children started school when they were five and a half or older. This was also reported in Tymms et al. (2004) and mirrors trends seen in the Growing Up in Scotland study, which published findings in 2012 indicating that 9% of children were older than five and a half years when they started school in the cohorts that they had studied. Interestingly, 15% of boys had their entry deferred compared with 9% of girls in the study (Bradshaw et al., 2012). In Scotland, parents can request to defer their child's entry to school to the

following year under certain conditions and this leads to a number of children who are older than might be expected at the start of Primary 1. It is clear from Figure 3 that although the numbers are low, this approach was not restricted to very young children; based on the score linked to ages it is clear that those with delayed development are more likely to be kept back for a year. This is explored in Appendix E.

Children start school, on average, when they are six months older than children starting school in England. The distribution of ages at the start of school in England is more rectangular: For every month of birth there was about the same number of children. Although in England a small proportion of children start after Christmas and an even smaller proportion start after Easter.

3.1.4 Gender

The 2012/13 data set included 49.8% females and 50.2% males.

Figure 4: Proportions of males and females in the 2012/13 samples of PIPS data and the national data

Country	Female	Male
PIPS sample Scotland	49.8	50.2
PIPS sample England	48.1	51.9
National data for Primary 1 in Scotland 2012	48.9	51.1

The 2011 Census in Scotland reported that slightly more boys are born than girls (National Statistics 2012) with 51.2% of males in the 0-14 year's population. This is very close to the proportions of males seen in the national data for children in Primary 1 in 2012. The PIPS sample in Scotland has a slightly lower proportion of males to females, however, the proportions do vary by region, as reported by indexmundi (<http://www.indexmundi.com/facts/united-kingdom/quick-facts/scotland/sex-ratio#map>).

3.1.5 Pre-school experience

Although teachers were asked to complete information about their pupils' pre-school experience as part of the PIPS project, it is clear that many teachers did not complete that section of the PIPS questions; they may not have had that information to hand. Summary statistics are published by the Scottish Government (2014). The number of children in early learning and child care centres each year is reported but no information about the amount or quality of provision. The numbers are reasonably stable but there is a slight decline over time between 2007 and 2010, then an increase up to 2014.

3.1.6 English as an Additional Language

As with pre-school experience, the information provided by teachers within the PIPS assessment was sparse but the Scottish Government's Education Analytical Services Division extracted aggregated data relating to the schools included in this study as reported in Figure 5.

Figure 5: Percentages of children from ethnic minority groups and percentages with English as an additional language in Primary 1

	Ethnic minority	EAL
2012	4.2%	3.2%
2013	4.7%	4.4%
2014	4.7%	4.7%

Figure 5 indicates small and slightly increasing proportions of children from ethnic minority groups and children whose first language was not English in the sample. This is close to the pattern across Scotland as a whole.

3.2 Characteristics of the data sets for Primary 1 2012/13, 2013/14, 2014/15 trends over time analyses

3.2.1 Trends over time

The total sample of the three cohorts analysed to investigate trends over time comprised 19,578 pupils from 394 schools. The mean number of pupils in the schools was 50 (Standard Deviation =34.4; range between 1 and 168; median of 44). Details of the three cohorts are given in Figure 6. The figures for the 2012/13 cohort in the trends analysis are slightly different from the 2012/13 data used for the baseline and follow up analysis because the analysis excluded a number of additional cases as noted above.

The SIMD profiles, ages and proportion of boys/girls were consistent over time.

Figure 6: Pupil Demographics

	2012/13	2013/14	2014/15	Combined
Number of pupils with data	6526	6526	6526	19578
Gender				
Male, n (%)	3263 (50.4)	3345 (50.9)	3410 (51.2)	10018 (51.0)
Female, n (%)	3218 (49.7)	3177 (49.1)	3116 (48.8)	9511 (49.0)
Age				
Mean (SD)	5.0 (0.31)	5.0 (0.31)	5.0 (0.31)	5.0 (0.31)
Median (min, max)	5 (4.5, 6.3)	5 (4.5, 6.5)	5 (4.5, 6.4)	5 (4.5, 6.5)
SIMD Decile				
1, n (%)	734 (11.3)	734 (11.3)	734 (11.3)	2202 (11.3)
2, n (%)	717 (11.0)	717 (11.0)	717 (11.0)	2151 (11.0)
3, n (%)	651 (10.0)	651 (10.0)	651 (10.0)	1953 (10.0)
4, n (%)	653 (10.0)	653 (10.0)	653 (10.0)	1959 (10.0)
5, n (%)	653 (10.0)	653 (10.0)	653 (10.0)	1959 (10.0)
6, n (%)	651 (10.0)	651 (10.0)	651 (10.0)	1953 (10.0)
7, n (%)	650 (10.0)	650 (10.0)	650 (10.0)	1950 (10.0)
8, n (%)	650 (10.0)	650 (10.0)	650 (10.0)	1950 (10.0)
9, n (%)	644 (9.9)	644 (9.9)	644 (9.9)	1932 (9.9)
10, n (%)	523 (8.0)	523 (8.0)	523 (8.0)	1569 (8.0)
Missing	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

4. Children's development at the start of Primary 1 and progress to the end of academic year 2012/13

4.1 The content of the PIPS assessment

General information about the PIPS assessment is available on the Centre for Evaluation and Monitoring's website³. In short, the assessment has two main parts: the first assesses cognitive development; and the second personal and social development. The first part is designed to assess those aspects which are the best predictors of later success or difficulty (Tymms, 1999a and 1999b; Tymms, Brien, Merrell et al, 2003; Tymms, Merrell, Henderson et al, 2012). PIPS is a computer-delivered assessment. The content of the cognitive part is extensive, but no individual child sees all of it, which means that a very wide range of children can be assessed in an efficient, reliable and enjoyable way. The cognitive part is made up of sections which assess *Early Mathematics*, *Early Reading*, *Picture Vocabulary* and *Phonological Awareness*. Children are assessed on a one-to-one basis within the first few weeks of them starting school, usually by their class teacher but sometimes by a teaching assistant or other adult. The computer asks the child questions which require the child to respond either verbally or by pointing to the screen. The teacher records the child's answers as correct or incorrect on-screen. Each section begins at a very easy level and the questions increase in difficulty. When the child starts to make mistakes, the assessment moves on to the next section, beginning once again at an easy level. The cognitive section usually takes between 15 to 20 minutes per child. At the end of Primary 1, children are assessed once again. Rather than starting at the very beginning, the assessment takes account of where a child started to falter in the start of year assessment and resumes at that point.

The constructs assessed in the cognitive part of PIPS are shown in Figure 7.

³ <http://www.cem.org/pips-baseline/introduction>

Figure 7: Constructs assessed in the cognitive part of PIPS

Construct	Description
Writing	Writing – the child is asked to write his/her own name and the quality of writing is scored against examples
Vocabulary	Vocabulary – the child is asked to identify objects embedded within a picture
Ideas About Reading	Ideas about reading – assesses many of the ideas found in Marie Clay's Concepts about Print (Clay 1972)
Phonological awareness	Repeating Words - the child hears a word and is asked to repeat it Rhyming Words – the child selects a word to rhyme with a target word from a choice of three options
Letters	Letter identification – a fixed order of mixed upper and lower case letters
Early Reading	Word recognition and reading This starts with word recognition and moves on to simple sentences that the child is asked to read aloud. The words within these sentences are high frequency and common to most reading schemes. This is followed by two more difficult comprehension exercises called 'Walking to school' and 'Cats' which require the child to read a passage and at certain points select one word from a choice of three that best fits that position in the sentence
Ideas About Mathematics	Ideas about mathematics – assessment of understanding of the vocabulary associated with mathematical concepts
Counting	Counting and numerosity – the child is asked to count four objects. These disappear from the screen and then the child is asked how many objects they saw. This is repeated with seven objects
Digits	Digit identification – single, two-digits and three-digits
Shapes	Identification of a variety of geometric shapes
Number	Number manipulation – the child is asked how many more or less a number is than a target
Sums A	(Informal) Sums – addition and subtraction problems presented without symbols
Sums B	(Formal) More difficult mathematics problems including sums presented with formal notation

The personal and social development is completed by teachers on the basis of their observations of their pupils' behaviour in the school setting. It includes 11 scales as shown in Figure 8. See Appendix B for full descriptors of all scales.

Figure 8: Personal and social development scales of PIPS

Construct	Description
Adjustment to the school setting	Comfortable – Is the child comfortable upon separation from main carer at the start of the day and do they cope easily with transitions within the school day?
Personal	Independence – Level of support and guidance needed for personal care and activities Confidence Concentration on self-directed activities Concentration of teacher-directed activities
Social	Actions – Consideration of others Relationships with peers Relationships with adults Rules – takes notice of rules Cultural awareness Communication

Each scale has five points, accompanied by a description . The teacher rates each child on the description that most closely matches his/her behaviour.

4.2 Item maps at the start of Primary 1

A statistical method called Rasch measurement was used to transform the raw scores of children into measures on an objective interval scale. This interval scale can be thought of as a ruler upon which an estimate of each child's developed ability can be placed as can the difficulty level of each of the questions (referred to as 'items' in this section) in the assessment. The unit of measurement of this 'ruler' is referred to as a logit.

Item maps of children's cognitive development were then constructed. These are explained below.

4.2.1 The full PIPS cognitive development scale

Figure C-1 in Appendix C shows an item map which includes all of the constructs assessed in the cognitive development part of PIPS. Children's developed ability levels and the difficulty of all of the questions are placed on the same logit scale. The children's developed ability levels are shown on the left side of the scale under the 'Person' column. The 'Measure' column at the left side of the map shows the logit scale which, in this instance, ranges from -6 to +7. The difficulty of the questions is shown in the right side of the map. The higher the value on the logit scale, the more able the child and also the more difficult the item.

The 'M's on the scale denote the mean score of the children and the mean difficulty of the cognitive development scale. Looking at the item map, we can see that children's developed ability levels are 'normally' distributed: There are a few children of very low and very high ability, with the majority in the middle, average, range. The mean ability of the children is very close to the mean difficulty of the items, which suggests that the assessment was of an appropriate difficulty. It was neither too easy for most children nor too difficult.

Each of the questions in the assessment has an ID, and these are presented in the item map. The first part of the question ID generally corresponds to the names of the constructs listed in Figure 7, which enables us to see what area they are assessing. The most difficult items are within the Sums B and Number sections, and the 'Walking to school' and 'Cats' sections of the reading comprehension. Questions such as 'What is twice three, doubled?' and 'What is 21 more than 32?'. Virtually no children were able to answer these at the start of Primary 1 and with the adaptive nature of the assessment, they would not have been presented with them.

At the easier end of the scale, most children were able to identify items which were assessing their vocabulary acquisition such as 'carrots', 'a bowl' and 'some cherries' from within a picture of a kitchen, to differentiate between the biggest item from a set of three and the smallest, and to identify simple 2D shapes.

Children within the average range of ability were typically able to identify several letters, identify a microscope within a scene from the vocabulary section, identify single digits and answer early mathematics questions such as 'here are six ice creams, if I took three away, how many would be left?'.

This item map has particular formative value for teachers when considering what children know and can do at the start of Primary 1, providing information about the learning progression so that they can pitch their teaching appropriately. At policy level, such an item map could make an important contribution to curriculum design, providing information about the order in which children of this age acquire conceptual understanding in various areas.

4.2.2 Early mathematics

Figure C-2 of Appendix C is an item map which shows more clearly the early mathematics scale.

The children's abilities were normally distributed, which means that the majority of children's scores were close to the average and that fewer and fewer scores appeared at higher and lower values. In terms of what children know and can do, the vast majority were able to identify the biggest and smallest cats from a picture containing three cats. They could identify a star and a circle from a choice of differently shaped balloons, count up to four objects and identify the number 1. At the top end of the ability range, some children entering Primary 1 were able to identify three-digit numbers and perform arithmetic such as $15 + 21$. This illustrates the very wide range of children's abilities and mathematical conceptual understanding for which Primary 1 class teachers need to cater.

4.2.3 Early reading

Once again, a normal distribution of abilities was found. On the early reading scale, children at the lower end of the ability range were able to distinguish between someone who is reading and someone who is writing in a picture scene of a classroom. They were able to repeat the word 'stop'. On average, children starting Primary 1 were able to identify several letters of the alphabet, repeat words with three syllables, and identify rhyming words when presented to them in a multiple

choice format with sounds accompanied by pictures (e.g. Listen to these words – sun, fish, run, knife – which word rhymes with sun?). The most able children could recognise words from a multiple choice format, and decode words such as ‘shop’ ‘always’, ‘night’ and ‘play’ in order to read sentences aloud.

4.2.4 Picture vocabulary

The item map (Figure C-4 of Appendix C) indicates that several of the vocabulary items in this section were very easy for the majority of children. Nevertheless, the vocabulary of a small number of children was quite limited, identifying only very common objects such as cherries, a knife, a fork and a kite. At the upper end of the ability range, a small number of children had a much more extensive acquisition of vocabulary as indicated by their ability to identify a yacht and some cosmetics.

4.2.5 Phonological awareness

The phonological awareness scale includes just 17 items. The rhyming words section is abbreviated to ‘Rhy’ and the repeating words section abbreviated to ‘Rep’ in the item map in the Appendix C. Like the picture vocabulary section, many of the questions were very easy for the majority of children, however, some children were not able to repeat words accurately or understand the concept of rhyming. It is important for teachers to identify these children and intervene at an early stage to improve their phonological awareness, which is such an important precursor of reading.

4.3 Differences between groups on the cognitive measures at the start of Primary 1

Before investigating differences between groups, the strength of the relationship between the areas of development for the full sample is explored. A score for each pupil was calculated by totalling the number of items which they answered correctly within a sub-scale. The total of all sub-scales made up a pupil’s total score. The correlations between sub-scales⁴ are shown in Figure 9. These correlations show how strong the relation is between pupils’ scores on, for example, early reading and early mathematics.

Figure 9: Correlations between the scales for children in Scotland at the start of Primary 1

	Total	Early Reading	Early Mathematics	Vocabulary	Phonological Awareness
Total	1	.90	.88	.60	.65
Early Reading	.90	1	.71	.42	.45
Early Mathematics	.88	.70	1	.47	.52
Picture Vocabulary	.60	.42	.47	1	.45
Phonological Awareness	.65	.45	.52	.45	1

⁴ The scores were normalised before the correlations were calculated.

The correlations are based on 6,622 cases. All correlations were significant at the 1% level. There is a fairly strong correlation between early reading and early mathematics, which indicates that children with high scores in early reading tended to also have high scores in early mathematics. This was a strong trend but there is still some variation within it, meaning that, for example, some children might attain a very high score in early reading but a lower score in early mathematics. Vocabulary and phonological awareness were more weakly correlated with early reading and early mathematics. It is interesting to note that whilst vocabulary and phonological awareness are assessing elements of language acquisition and processing, they were more strongly correlated with early mathematics than with early reading.

4.3.1 Age

Next, the relationship between age at the start of Primary 1 and development level is investigated.

Figure 10: Correlations with age at the start of Primary 1

Measure	Correlation with age at the start of Primary 1
Total	0.20**
Early Reading	0.17**
Early Mathematics	0.16**
Picture Vocabulary	0.14**
Phonological Awareness	0.14**

** Significant at the 1% level * significant at the 5% level

The correlations between age at the start of Primary 1 and the PIPS total score and sub-scales were weak but all statistically significant. The level of significance suggests a high level of confidence in the relationship existing even though it is a weak one. The strongest correlation was seen for the total score. These correlations indicate a general trend of older children tending to achieve a higher score on the PIPS assessment than the younger children in the cohort at the start of Primary 1.

4.3.2 Gender

The differences between boys' and girls' scores on the PIPS assessment cognitive scale and sub-scales are reported in Figure 11. The mean difference has been transformed and is presented in months of development.

Figure 11: Differences between the sexes at the start of Primary 1

Measure	Female advantage in months	Standard Deviation Male: Female
Total	3.3**	18.8 : 17.7 *
Early Reading	3.6**	22.5 : 21.6
Early Mathematics	0.5	20.5 : 17.5 **
Picture Vocabulary	5.4**	26.3 : 25.0
Phonological Awareness	5.6**	26.6 : 25.4**

**** Significant at the 1% level * significant at the 5% level**
The significance of the Standard Deviations refers to a comparison of males and females expressed in months

On average, girls achieved higher scores at the start of Primary 1 than the boys in early reading, vocabulary and phonological awareness although the standard deviations show that there was a wide range of scores for both sexes. The difference is much smaller for early mathematics at just half of one month. The standard deviations were always greater for boys than girls suggesting that the highest and lowest scorers will have higher proportions of boys.

4.3.3 Deprivation

The Scottish Index of Multiple Deprivation (SIMD) was used as an estimate of each pupil's level of deprivation. The overall SIMD scale was divided into quintiles (five groups in which 1 is the most deprived and 5 the least deprived) and the correlations between PIPS scale and sub-scales, and the SIMD quintiles are reported in Figure 12.

Figure 12: Correlations with SIMD (quintiles) at the start of Primary 1

Measure	Correlation with SIMD	Months between highest and lowest quintiles
Total	0.27**	14.4
Early Reading	0.23**	15.4
Early Mathematics	0.23**	13.0
Picture Vocabulary	0.19**	13.8
Phonological Awareness	0.20**	15.1

**** Significant at the 1% level * significant at the 5% level**

Figure 12 presents the correlation between SIMD quintiles and the cognitive measures. It also shows the differences in terms of months of development between children in the highest and lowest SIMD quintiles. The relationships between deprivation and cognitive development were significant but the correlations are weak. For the total score, children from the most affluent areas were 14.4 months ahead of the children from the most deprived areas. Looking in more detail there was a larger difference in early reading, phonological awareness and vocabulary than early mathematics.

Figure 13: The link between the PIPS total score and SIMD quintiles at the start of Primary 1

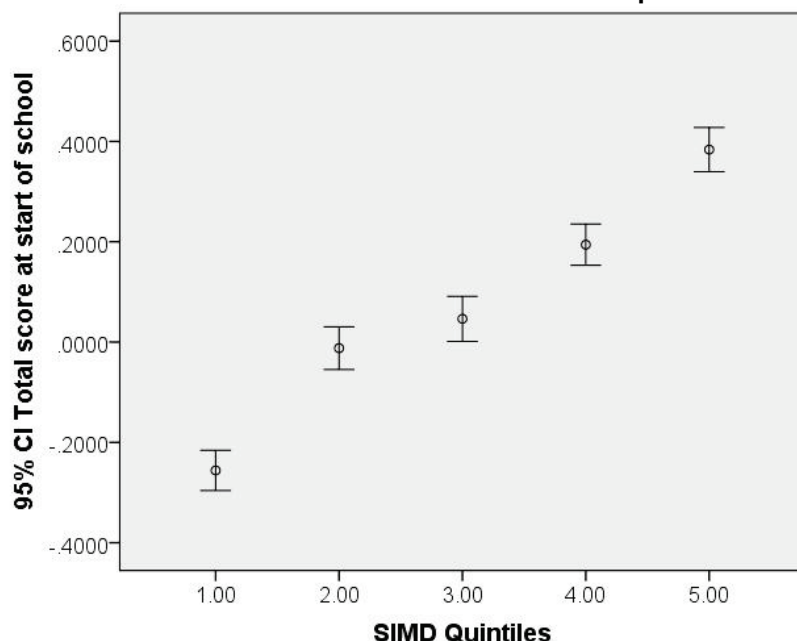
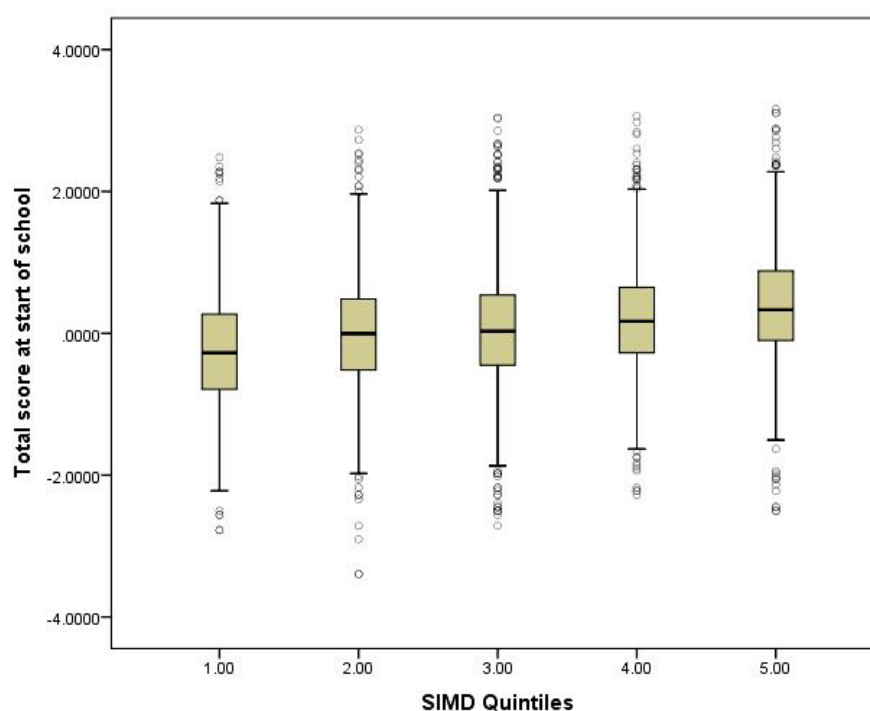


Figure 13 shows the mean and 95% confidence intervals⁵ for the normalised PIPS total score at the start of Primary 1 by SIMD quintiles. The PIPS total score is shown on the vertical axis and the average score is zero. A clear trend is seen with the children from the lowest SIMD quintile having the lowest mean PIPS total score and those from the highest SIMD quintile having a correspondingly high mean PIPS total score.

Figure 14: Box and whisker plot of the PIPS total score by SIMD quintiles



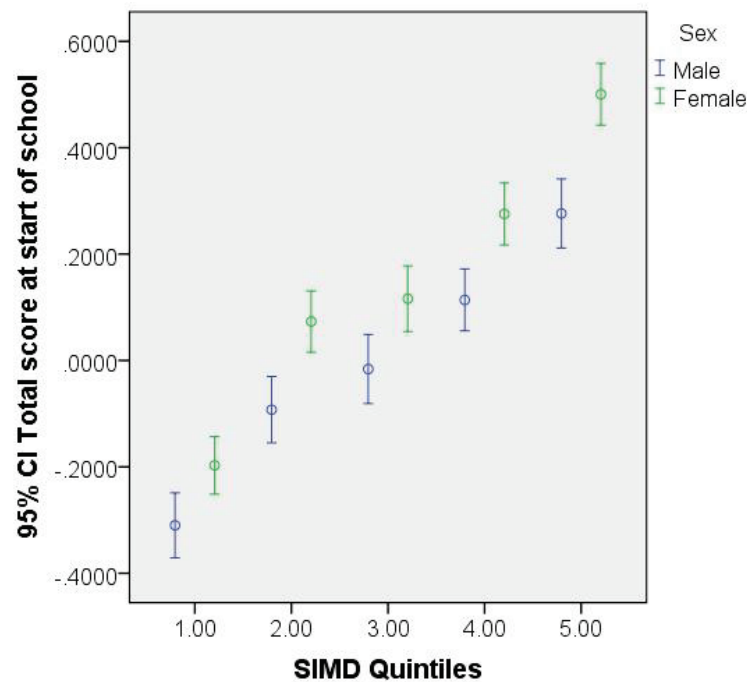
⁵ All assessments have an error of measurement. They give an indication of the uncertainty around the estimates of a child's level of ability. The 95% confidence interval shows the range around a score within which we are 95% confident the true score lies.

Figure 13 emphasised the clear relationship between pupils' SIMD quintiles and their PIPS score at the start of school. However, that method of presentation conceals the wide variation amongst pupils. Figure 14 shows the range of scores within each quintile. Each central box represents the range of scores of the middle 50% of pupils in the sample. The line in the middle of the box shows the score of the median pupil in the sample. The top and bottom whiskers encompass almost all cases and just a few outliers are shown above and below. The top 25% of children in the lowest quintile have higher total scores than the bottom 25% of the highest quintile.

4.3.3.1 Are boys or girls particularly affected by deprivation?

The possible differential effects of deprivation on boys and girls were investigated and Figure 15 shows the mean scores and 95% confidence intervals for the PIPS total score.

Figure 15: The link between the PIPS total score at the start of Primary 1 and SIMD by sex



It has been suggested that there could be an interaction between sex and deprivation, with boys' development being further behind that of girls in the lower quintiles. Figure 15 shows that the girls' scores were higher than boys' within all quintiles. The boys' scores were not relatively lower than the girls' within the lowest quintile compared with higher quintiles. Differences between boys and girls actually increased by increasing quintile suggesting that there was a slightly bigger gap between the two groups in the highest quintile compared with the lowest.

4.4 Levels of personal and social development (PSD): differences between groups

Before investigating differences between groups, the mean scores and standard deviations for each scale within the personal and social development (PSD) assessment are presented. It should be noted that the sample size for PSD is much smaller than for the cognitive development scale. This was an optional part of the assessment which fewer teachers chose to complete.

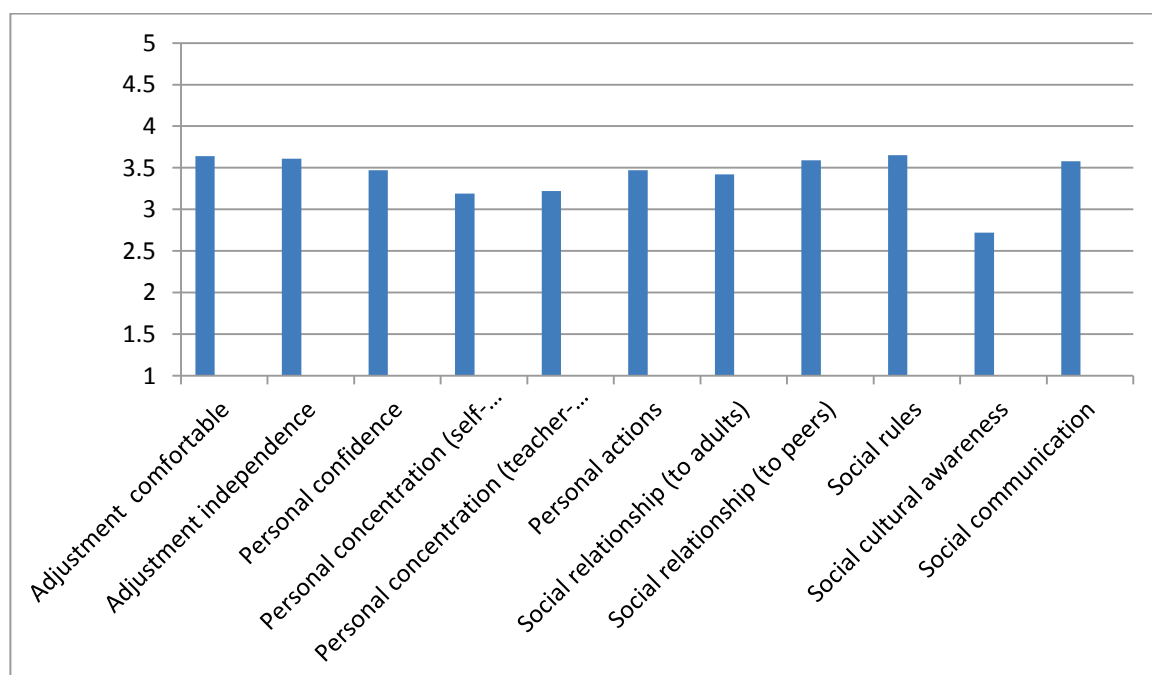
Teachers were asked to observe their pupils for the first few weeks of Primary 1 before completing the PSD assessment. A pupil was assigned a score between 1 and 5 for each scale, with a score of 5 representing the highest level of development. The mean scores and standard deviations are shown in Figure 16.

Figure 16: PSD mean scores and standard deviations in the first term of Primary 1

	N	Mean	Standard Deviation
Adjustment comfortable	669	3.64	1.08
Adjustment independence	667	3.61	1.07
Personal confidence	667	3.47	0.98
Personal concentration (self-directed)	667	3.19	0.99
Personal concentration (teacher-directed)	660	3.22	0.95
Personal actions	660	3.47	0.96
Social relationship (to adults)	660	3.42	0.85
Social relationship (to peers)	660	3.59	0.86
Social rules	660	3.65	0.89
Social cultural awareness	660	2.72	1.04
Social communication	660	3.58	1.06

Figure 17 presents the mean score of each scale graphically.

Figure 17: PSD ratings in the first term of Primary 1



Children are rated most highly on their adjustment to the school setting, their independence within the school setting, relationships with peers, awareness of rules and communication. Cultural awareness was rated lowest of all. Another area with lower scores was concentration, both for self-directed activities and teacher-directed activities.

4.4.1 Age

Figure 18: Correlations between PSD and age in the first term of Primary 1

	Correlation with age
Adjustment comfortable	0.04
Adjustment independence	0.06
Personal confidence	0.05
Personal concentration (self-directed)	0.07
Personal concentration (teacher-directed)	0.04
Personal actions	-0.03
Social relationship (to adults)	-0.02
Social relationship (to peers)	-0.05
Social rules	-0.02
Social cultural awareness	0.08*
Social communication	0.00

** Significant at the 1% level * significant at the 5% level

There is essentially no relationship between PSD and the age of the children. Although one correlation was statistically significant it was a very weak relationship. This contrasts with England where the relationship with age was stronger; older children scored more highly than younger children on Personal confidence (the correlation was 0.45) and the weakest correlation was for Social cultural awareness (0.23). Quite why differences are seen between England and Scotland in this respect is unclear. Perhaps it has something to do with pre-school preparation or attitudes in the home or the approach taken to ratings by teachers.

4.4.2 Gender and deprivation

The differences between PSD ratings for boys and girls, and for pupils from different SIMD areas were investigated.

Figure 19: Differences in the mean PSD scores for gender and deprivation

	Female advantage	Most affluent – most deprived quintile
Adjustment comfortable	0.11*	0.43**
Adjustment independence	0.28**	0.27
Personal confidence	0.20**	0.11
Personal concentration (self-directed)	0.45**	0.31*
Personal concentration (teacher-directed)	0.41**	0.43**
Personal actions	0.44**	0.24
Social relationship (to adults)	0.29**	0.35**
Social relationship (to peers)	0.25**	0.16
Social rules	0.39**	0.34**
Social cultural awareness	0.26**	0.45**
Social communication	0.34**	0.39*

**** Significant at the 1% level * significant at the 5% level**

Several of the differences were statistically significant. The largest differences between boys and girls were seen on the concentration and personal actions scales where girls were almost half a point ahead of boys on the five-point scale. The personal actions scale measures elements of impulsivity and consideration of others. Taken together, they loosely encompass inattention, hyperactivity and impulsivity, which are traits more frequently displayed by boys than girls (Merrell and Tymms, 2001).

Children from the most affluent backgrounds scored more highly than those from the most deprived areas on the adjustment to school and concentration on teacher-directed activities.

4.5 Progress in cognitive development and PSD in Primary 1

4.5.1 Cognitive development

Figure 20 summarises the amount of progress in months made by children during Primary 1. This shows the impact of spending a year in school. As shown in the item maps earlier, children typically start Primary 1 being able to recognise some of the letters of the alphabet and recognising one or two high frequency words, recognising most single digits and a few teens. By the end of the year, many are competent in decoding many words and understanding their meaning, and performing arithmetic. In statistical terms, children made many months of progress in school compared with if they hadn't attended. Extrapolating from the rate of progress seen in Primary 1, it is estimated that if children did not go to school, it would take them more than four more years before they were able to read at the same level, and three years to perform at the same level in early mathematics. School really does make a difference.

Figure 20: Months of progress after the year in Primary 1⁶

Measure	Progress in months
Total	44**
Early Reading	52**
Early Mathematics	38**
Picture Vocabulary	60**
Phonological Awareness	28**

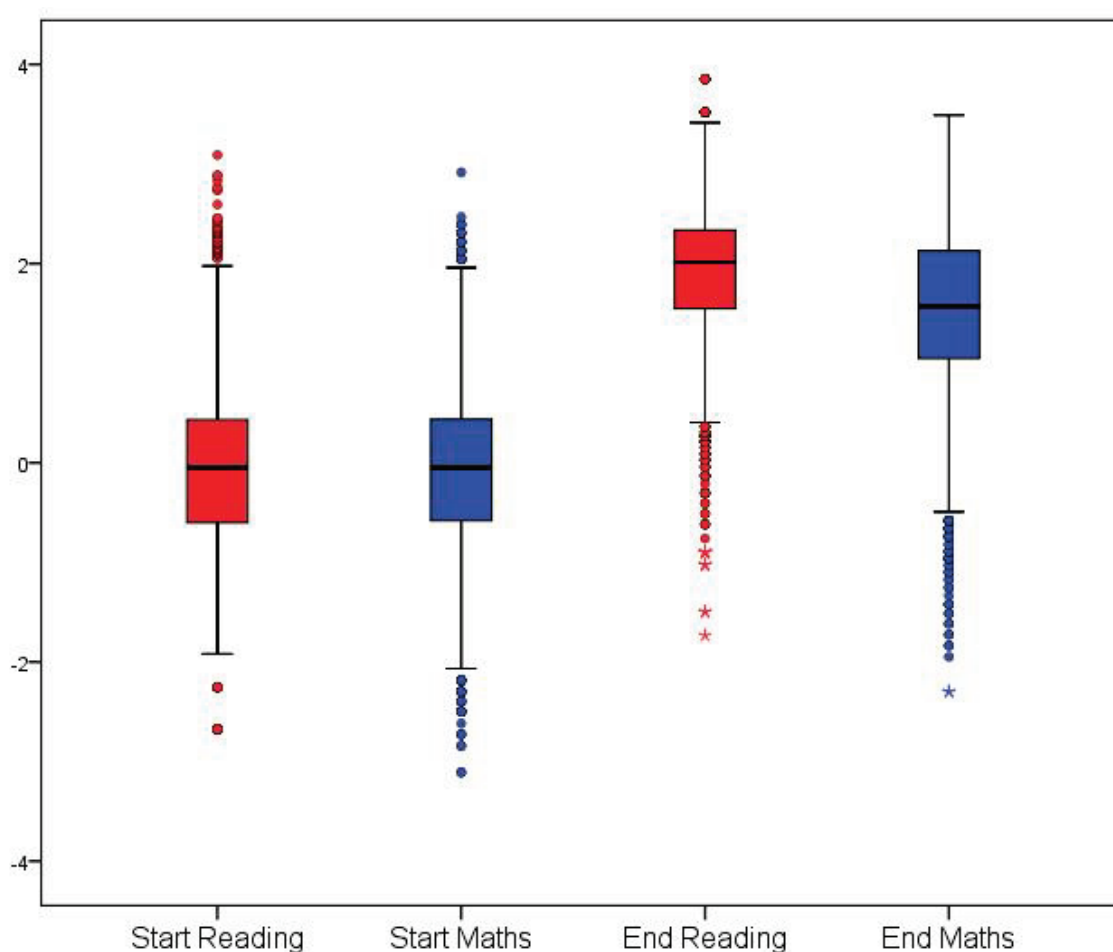
**** Significant at the 1% level * significant at the 5% level**

Figure 21 shows the range of early reading and early mathematics scores at the start and end of Primary 1 using box and whisker plots⁷.

⁶ This was based on subtracting the start score from the end scores using the normalised start scores as the base.

⁷ As before each central box represents the range of scores of the middle 50% of pupils in the sample. The line in the middle of the box shows the score of the median pupil in the sample. The top and bottom whiskers encompass almost all cases and just a few outliers are shown above and below.

Figure 21: The range of PIPS early reading and early mathematics scores at the start and end of Primary 1



The reading scores changed dramatically from the start of the year to the end of the year. At the end of the year, the median score, corresponding to the 50th percentile⁸, is in line with the top of the distribution at the start of the year. The children made many more months of progress in school than would be expected from natural maturation. These gains are not only statistically significant but also educationally very substantial.

Similar but slightly less dramatic progress was seen in early mathematics.

4.5.2 Differences between groups

4.5.2.1 Age, gender and deprivation

Figure 22 reports the differences in progress between older and younger children, boys and girls, and children from the highest and lowest SIMD quintiles on the PIPS total score and the sub-scales.

⁸ A percentile indicates the percentage whose scores fall below a given value. Children whose scores were on the 50th percentile at the start of Primary 1 were thus in the middle of the range.

Figure 22: Differences in progress in Primary 1 related to key variables expressed in months

	Age (for one year older)	Sex (Female advantage)	SIMD (Top quintile advantage over lowest quintile)
Total	-1.2	2.1**	1.3
Early Reading	-0.4	1.8**	2.2**
Early Mathematics	0.6	- 1.7**	-0.4**
Picture Vocabulary	-4.3**	0.2	2.2*
Phonological Awareness	-1.3	0.4	1.0

** Significant at the 1% level * significant at the 5% level

The results in Figure 22 indicate that the younger children make significantly more progress in vocabulary acquisition compared with their older peers; they begin to close the gap seen at the start of the year. The other age differences are not significant; older children and younger ones make a similar amount of progress over the year in reading, mathematics and phonological awareness.

Although statistically significant differences in progress were seen between boys and girls for early reading and early mathematics, these were very small in terms of gain in months (less than two months). Girls made more progress than boys in early reading but the reverse held for early maths.

Children in the least deprived SIMD quintile made more progress than their peers in the most deprived SIMD quintile for early reading and picture vocabulary (equivalent of over two months progress) where, perhaps, they are receiving more enriched support in their homes. But for early mathematics the children in more deprived areas caught up a little with their more affluent peers: the equivalent of 0.4 month of development.

NB We found no evidence that the link to disadvantage varies from school to school based on the sample – see Appendix F.

4.5.2.2 Deprivation

Multi-level models were used to investigate the amount of progress that pupils made taking into account their age at the start of Primary 1, SIMD and their PIPS total score at the start of Primary 1. These models take account of the grouping of pupils within different schools.

The models were used to produce Figure 23 which shows the difference in progress made by children in schools with high and low progress⁹.

⁹ This is schools which were one standard deviation above the mean school compared with those one standard deviation below on the progress measures.

Figure 23: Differences in progress related to schools expressed in months (difference between schools which were one standard deviation above and below the mean school)

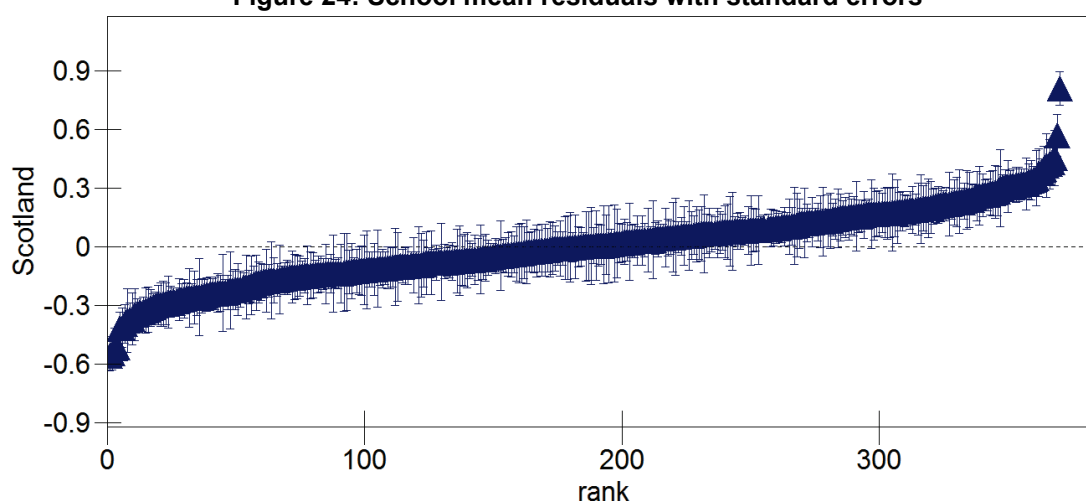
	School
Total	10**
Early Reading	12**
Early Mathematics	14**
Picture Vocabulary	8.5**
Phonological Awareness	8.3**

** Significant at the 1% level * significant at the 5% level

There is a very large difference between schools in terms of the progress made by children during Primary 1. If we look at the amount of progress on the total score made by pupils in the school which was one standard deviation above average (on the 84th percentile) or one standard deviation below average (on the 16th percentile) then the difference between their progress is equivalent to 10 months.

Figure 24 shows the mean residual¹⁰ of each school for the PIPS total score with the standard error after controlling for (i.e. taking account of) age at the start of Primary 1, deprivation level and PIPS total score at the start of Primary 1. The standard error shows the range in which we are 95% confident the true scores lie. It enables the reader to see the distribution of schools' scores. Looking at the horizontal axis, pupils in those schools at the left side were making less progress than those on the right. The mean score is denoted by a triangle. (There are so many schools that the triangles in the diagrams merge together to look like a thick blue line.) If the confidence intervals overlapped with the middle horizontal axis, it was not significantly different from the mean. There were large differences between schools in the progress made. Not only was the average progress in Primary 1 larger than the impact of deprivation, age or sex on scores at the start of Primary 1 but the difference in progress across schools was larger than the impact of deprivation, age or sex on progress. More information about schools in England can be found in Tymms, Merrell and Henderson (1997).

Figure 24: School mean residuals with standard errors

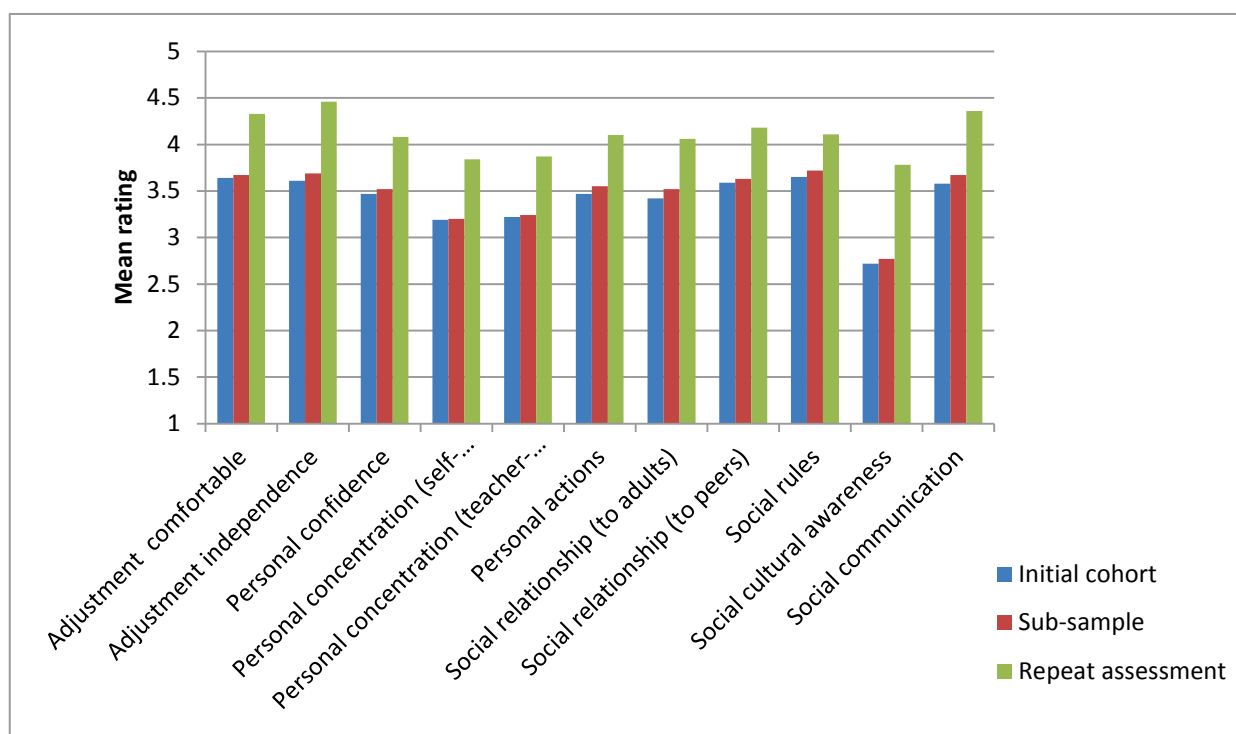


¹⁰ Statistically what is referred to as “progress” in this report is often referred to as “residuals”.

4.6 Personal and social development

Although data were collected from more than 600 pupils during the first term of Primary 1, only 339 children were assessed again at the end of the year. Figure 25 shows the start of year scores of the initial sample of 669 children (labelled 'initial cohort' in the Figure), the start of year scores of those pupils who were assessed at both the start and end of Primary 1 (labelled 'sub-sample' in the Figure), and the end of Primary 1 scores for that sub-group (labelled 'repeat assessment' in the Figure).

Figure 25: Personal and social development at the start and end of Primary 1



The scores at the start of Primary 1 for the sub-sample of children who were assessed at both time-points were close to the full sample. Progress during the year can be seen across all areas. At the start of the year, social cultural awareness was the lowest rated of the scales and large gains were seen by the end of the year.

4.6.1 Differences between groups

Figure 26 shows the differences between groups in the progress between the start and end of Primary 1.¹¹

¹¹ They were calculated using a series of regression controlling for prior score and the square of the prior scores. The coefficients for age, sex and SIMD were used to prepare the table.

Figure 26: Change in raw score related to key variables

	Age (partial correlation)	Sex (Female advantage)	SIMD (Top quintile advantage over lowest quintile)
Adjustment comfortable	0.01	0.11	-0.10
Adjustment independence	0.05	0.20**	0.12
Personal confidence	0.02	0.15	0.50**
Personal concentration (self-directed)	-0.05	0.21*	0.38*
Personal concentration (teacher-directed)	-0.02	0.33**	0.29
Personal actions	-0.08	0.39**	0.22
Social relationship (to adults)	-0.12**	0.37**	0.25*
Social relationship (to peers)	-0.10*	0.22**	0.16
Social rules	-0.01	0.38**	0.32*
Social cultural awareness	0.00	0.43**	0.26
Social communication	-0.01	0.21*	0.20
** Significant at the 1% level * significant at the 5% level			

Age was generally unrelated to progress but girls tended to make more progress than boys. The children from less deprived backgrounds made more progress in confidence (half of one point on the five-point scale), self-directed concentration (a third of a point), relationships with adults (a quarter of a point) and attending to social rules (a third of a point).

Figure 27: Change in raw score related to school based on 26 schools and 339 cases¹²

	School
Adjustment comfortable	0.56*
Adjustment independence	0.47*
Personal confidence	0.41
Personal concentration (self-directed)	0.55
Personal concentration (teacher-directed)	0.75*
Personal actions	0.59*
Social relationship (to adults)	0.58*
Social relationship (to peers)	0.55*
Social rules	0.55*
Social cultural awareness	1.00**
Social communication	0.86**
** Significant at the 1% level * significant at the 5% level	

There were large differences in children's rates of progress in PSD across schools. The differences in Figure 27 were based on a comparison of the schools which were one standard deviation below the mean and one standard deviation above the mean. As with the cognitive measures, the comparison was between the schools on the 16th and 84th percentiles. The largest difference was seen for progress in cultural awareness amounting to one point on the five-point scale. The changes were invariably¹² larger than the difference linked to sex, age or deprivation at the start of Primary 1 or when linked to progress.

¹² As for the cognitive measures multiple level models with the controls used for the previous table were used. The figures show the difference between schools a standard deviation (SD) above and below the school mean.

5. Comparisons with England

5.1 Representativeness and size of the sample

The data set used for the purpose of comparison is one which was previously analysed for a report to the Department for Education, England. The cohort started in school in the Reception year, aged four, in the 2011/12 academic year. A description of the method used to establish the representative sample of children starting school in England is described in that report (Tymms et al., 2014). It comprised 6,983 children at the start of the Reception year and 5,939 children completed the follow-up assessment at the end of the school year.

5.2 On entry to school

A full picture of children in England may be found in the publication by Tymms et al. (2014). Some comparisons are drawn between children starting school in England and Scotland in the paragraphs below.

5.2.1 Early mathematics

A high proportion of children starting school in England were able to identify single digit numbers such as 6 and 9, but two digit numbers were beyond most. Similarly the question “What is two more than six?” was beyond the ability of most children at this stage. Whilst the order of difficulty of the items was very similar for children in both England and Scotland at the start of school, the children starting school in Scotland were, on average, slightly more advanced, which was partially explained by them being older at that stage. But age for age there was still a slightly higher starting point in Scotland in the order of two months of cognitive development. For more details, see Tymms et al. (2014).

5.2.2 Early reading

The early reading scores of children starting school in Scotland were normally distributed, which means that they were distributed in a bell shape: most children scored around the mean, with decreasing numbers having higher or lower scores. The scores in England were skewed with a higher proportion of children clustering at a lower level than in Scotland. Compared with England the standard deviation was smaller, meaning that the children’s scores were more closely grouped together. The children in Scotland were able to identify far more letters than their English peers. This seems to be partly a reflection of them being older at the start of school but it may also reflect different values and cultures in the home, and an emphasis in pre-school. As for early mathematics, age for age, children starting school in Scotland were at a higher point amounting to approximately 4 months of cognitive development. For more details, see Tymms et al. (2014).

5.2.3 Personal and social development

Children's personal and social development was rated lower in England, with the mean score on many scales being around three, while the mean score in Scotland was around 3.5. The scale with the highest mean score for pupils in England was the social rules scale and the lowest mean score was the social cultural awareness scale. The social cultural awareness scale also had the lowest mean score for the children in Scotland. The children in Scotland were rated highly on their comfort and independence in the school setting compared with England. Again, this is partly because they were older but even taking age into account the children in Scotland had slightly higher rating which is perhaps a reflection of pre-school and home experience. But we should interpret the data with caution because of the small sample sizes and because ratings are judgments by individuals and not objective.

5.3 Progress

5.3.1 Early mathematics

The progress made by children in England and Scotland in mathematics in their first year was almost identical and did not differ statistically.

5.3.2 Early reading

The children made a little less progress in reading in Scotland than in England by about 4 months although Scotland started at a slightly higher level and age for age at the end of the year the average scores were in line with one another.

5.3.3 Personal and social development

We could not make fair comparisons between England and Scotland on the progress made in PSD because the reduced samples were not directly comparable and because the scores were starting to hit the maximum possible score for both groups towards the end of the year.

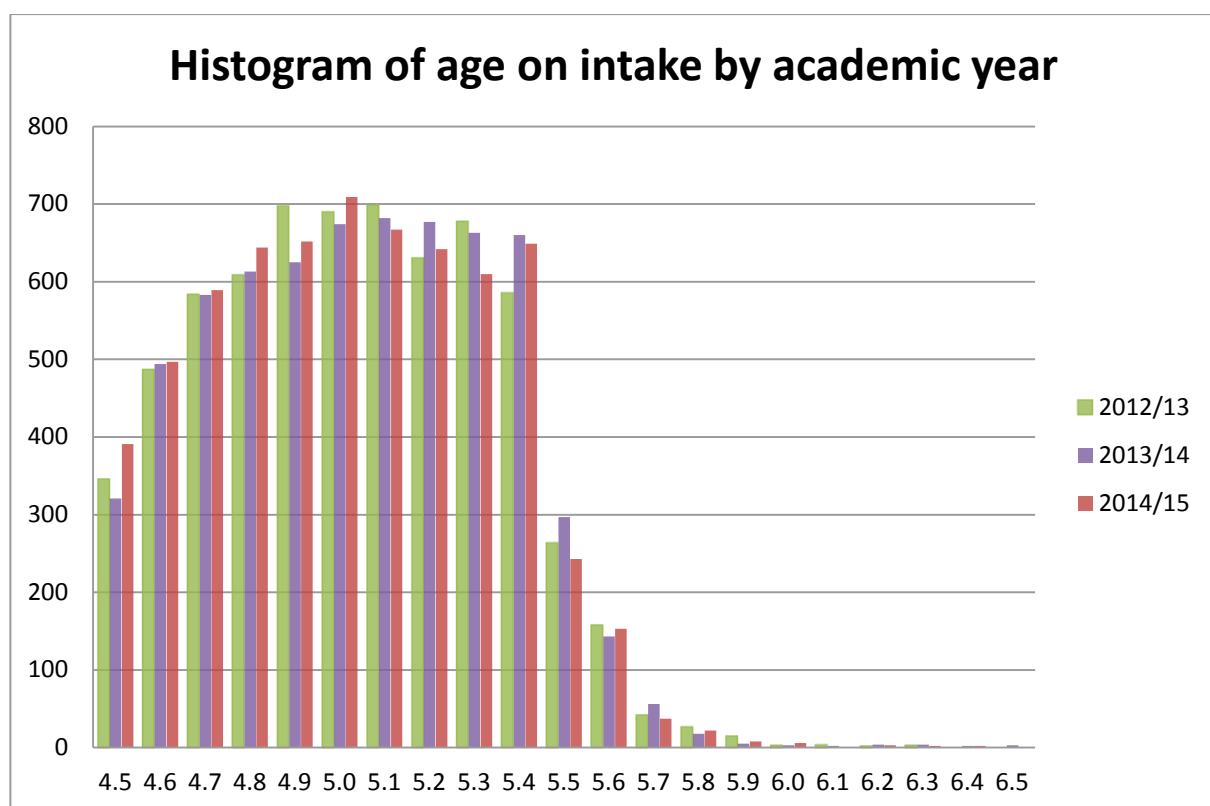
6. Trends over time for 2012/13, 2013/14 and 2014/15

This section investigates trends over time for three academic years.

6.1 Age on entry

The chart below shows the distribution of age on entry for the three cohorts.

Figure 28: Comparison of age of entry by cohort



The distributions across the three years are very similar and as reported in Figure 6 the mean age remained constant at 5.0 years. There remained a higher proportion of older children starting school than would be expected, reflecting those whose parents had opted to defer entry for one year as discussed previously.

6.2 Start of Primary 1

6.2.1 Cognitive development

Figure 29 shows the change, in months, in total PIPS scores, early reading and early mathematics at the start of Primary 1 over the three academic years.

Figure 29: Months difference in start of year scores between academic years

	2013/14 compared with 2012/13	2014/15 compared with 2013/14
Total	-1.21**	-1.72**
Early Reading	-0.99**	-2.96**
Early Mathematics	-0.99**	-1.28**

** Significant at the 1% level * significant at the 5% level

At the start of year, the scores for cognitive development declined between 2012/13 and 2013/14, and again between 2013/14 and 2014/15; this was statistically significant.

Between 2012/13 and 2013/14, the total score declined by 1.21 months of cognitive development and by 1.72 between 2013/14 and 2014/15. Looking more closely at early reading and early mathematics, the declines were similar for 2012/13 to 2013/14 but for 2013/14 to 2014/15, there was a larger decline for early reading than early mathematics. Over these same years, the demographics have changed a little in Scotland with an increase from 3.2% to 4.7% of children for whom English was an additional language. It is possible that this change is associated with the slight decline in PIPS scores however this is a hypothesis and it would need further exploration to establish a causal relationship. We were not able to identify children as having English as an additional language and so were not able to investigate the issue further.

Other research (<http://www.gov.scot/Resource/0048/00486755.pdf>) found an increase in children's vocabulary acquisition at age three years between 2004 and 2010 and a similar trend of increasing vocabulary might be expected within the current study. However, as said we found a drop in vocabulary over the three year period but it was very slight. For more detail, see Appendix D.

6.2.2 Cognitive measures with age, gender and deprivation

Figure 30 shows correlations of the cognitive measures over three years with the three key variables: age at the start of school, sex and deprivation level (SIMD).

Figure 30: Correlations between cognitive measures, age, sex and SIMD at the start of Primary 1 by academic year

		2012/13	2013/14	2014/15
Picture vocabulary	Age	0.12*	0.10*	0.12*
	Sex	0.10*	0.11*	0.14*
	SIMD	0.18*	0.16*	0.19*
Early mathematics	Age	0.19*	0.19*	0.20*
	Sex	0.02	0.02	0.04*
	SIMD	0.23*	0.20*	0.21*
Phonics	Age	0.14*	0.13*	0.13*
	Sex	0.10*	0.09*	0.12*
	SIMD	0.20*	0.17*	0.20*
Early reading	Age	0.15*	0.12*	0.15*
	Sex	0.06*	0.06*	0.09*
	SIMD	0.18*	0.16*	0.18*

**** Significant at the 1% level * significant at the 5% level**

There was some slight variation but the correlations can be considered to have remained stable over time¹³. This means that age, sex and deprivation level did not differentially impact on cognitive development over time.

6.3 Progress during Primary 1

The differences over the years at the end of Primary 1 can be found in Appendix D, Figure D-3. This section focuses on progress during Primary 1, and the months of difference between academic years is shown in Figure 31.

Figure 31: Months difference in progress between academic years

	2013/14 compared with 2012/13	2014/15 compared with 2013/14
Total	0.68**	0.69**
Early Reading	0.39	2.28**
Early Mathematics	1.06**	1.47**

**** Significant at the 1% level * significant at the 5% level**

Pupils' progress during Primary 1 in early reading and mathematics increased slightly over the three year period. These gains meant that there were no significant drops over the three years for mathematics levels at the end of Primary 1. For reading, a drop was still apparent although it was very small. It appears that the decline in children's cognitive development at the start of school over time was being compensated for by their time in school.

¹³ It is worth noting that even if a figure is significant one year and not the next this does not imply that there was a statistically significant difference between the two years.

6.4 Personal and social development

6.4.1 Start of Primary 1

Although the number of respondents decreased noticeably in 2014 the scores at the beginning of Primary 1 increased very slightly across all areas as the two figures below show. The mean was the average score of the five-point scale and the standard deviation (SD) indicates the spread of scores. For example, the Adjustment comfortable mean score was 3.6 on the five-point scale at the start of 2012/13. The standard deviation was 1.08, which implies that 68% of children had scores between 2.52 and 4.68 (3.6 plus or minus 1.08). The Adjustment comfortable mean score rose slightly to 3.7 in 2013/14 and then again to 3.9 in 2014/15. Over the three years, the mean score rose by 0.3 points on the five-point scale. Figure 32 gives details of the other PSD measures.

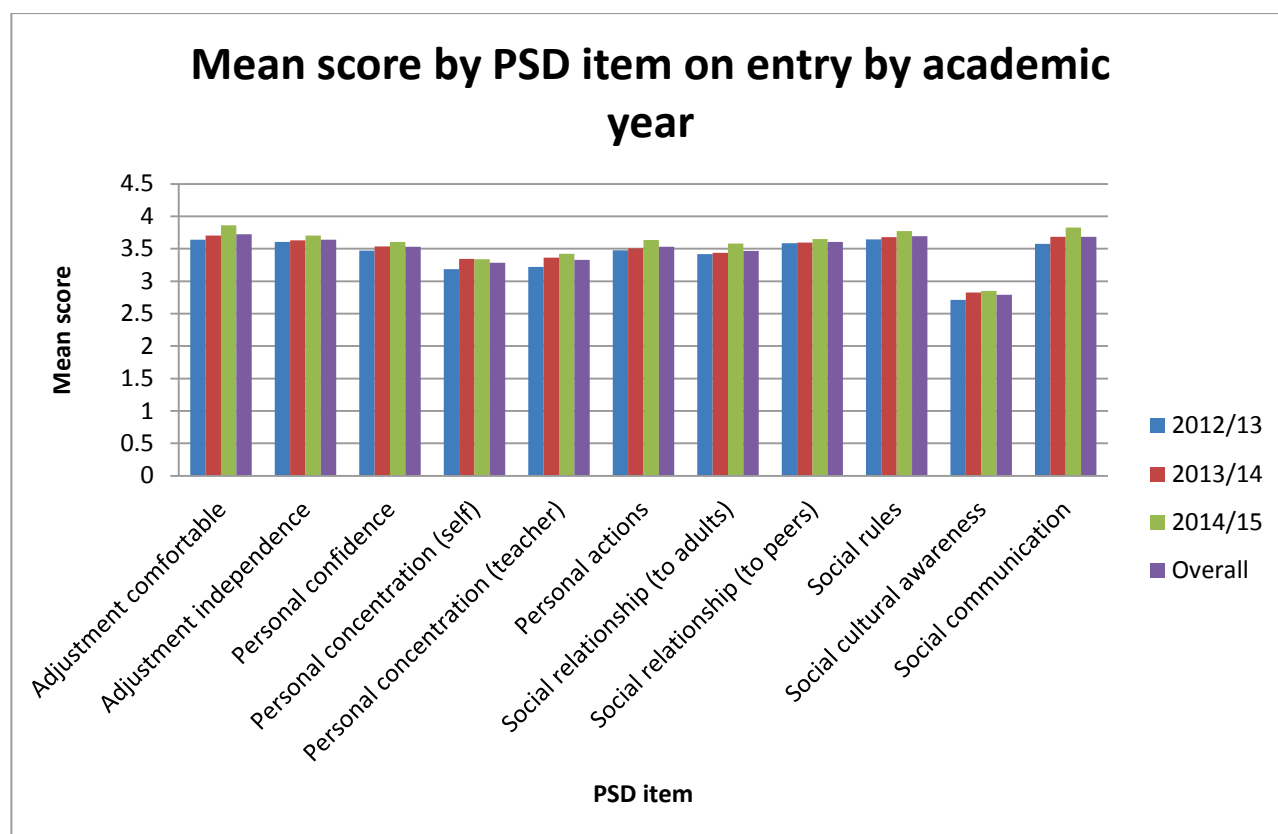
Figure 32: Personal and social development scores at the start of Primary 1 for three academic years

		2012/13	2013/14	2014/15	Overall
Adjustment comfortable, n		659	625	477	1761
	Mean (SD)	3.6 (1.08)	3.7 (1.08)	3.9 (1.05)	3.7 (1.07)
Adjustment independence, n		657	625	477	1759
	Mean (SD)	3.6 (1.07)	3.6 (1.08)	3.7 (1.14)	3.6 (1.10)
Personal confidence, n		657	622	477	1756
	Mean (SD)	3.5 (0.98)	3.6 (1.00)	3.6 (1.10)	3.5 (1.02)
Personal concentration (self-directed), n		657	623	477	1757
	Mean (SD)	3.2 (0.98)	3.3 (0.99)	3.3 (1.09)	3.3 (1.02)
Personal concentration (teacher-directed), n		650	623	477	1750
	Mean (SD)	3.2 (0.95)	3.4 (0.96)	3.4 (1.06)	3.3 (0.99)
Personal actions, n		650	623	477	1750
	Mean (SD)	3.5 (0.96)	3.5 (0.92)	3.6 (1.03)	3.5 (0.97)
Social relationship (to adults), n		650	623	477	1750
	Mean (SD)	3.4 (0.85)	3.4 (0.86)	3.6 (0.96)	3.5 (0.89)
Social relationship (to peers), n		650	623	477	1750
	Mean (SD)	3.6 (0.86)	3.6 (0.88)	3.7 (0.98)	3.6 (0.90)
Social rules, n		650	623	477	1750
	Mean (SD)	3.6 (0.89)	3.7 (0.85)	3.8 (0.98)	3.7 (0.90)
Social cultural awareness, n		650	623	477	1750
	Mean (SD)	2.7 (1.04)	2.8 (0.93)	2.8 (1.10)	2.8 (1.02)
Social communication, n		650	623	477	1750
	Mean (SD)	3.6 (1.06)	3.7 (1.02)	3.8 (1.12)	3.7 (1.07)

n=number of pupils; SD=standard deviation

The information in Figure 32 is shown graphically in Figure 33 below, which emphasizes the small degree of increasing scores on the five-point scales over the three years. The vertical axis shows the scores on the five-point scale.

Figure 33: PSD rating in the first term of Primary 1 over three years



6.4.1.1 Age, gender and deprivation

The correlations between age and PSD over time are shown in Figure 34.

Figure 34: Correlations between PSD and age at the start of Primary 1 for three academic years

	2012/13	2013/14	2014/15	Overall
Adjustment comfortable	0.04	0.11**	-0.02	0.05*
Adjustment independence	0.05	0.15**	0.09	0.10**
Personal confidence	0.04	0.15**	0.05	0.08**
Personal concentration (self)	0.06	0.14**	0.04	0.08**
Personal concentration (teacher)	0.04	0.14**	0.03	0.07**
Personal actions	-0.03	0.11**	-0.05	0.01
Social relationship (to adults)	-0.03	0.07	-0.04	0.00
Social relationship (to peers)	-0.06	0.10*	-0.05	0.00
Social rules	-0.02	0.09*	-0.04	0.01
Social cultural awareness	0.08*	0.09*	0.04	0.07**
Social communication	-0.01	0.06	0.04	0.03

** Significant at the 1% level

* significant at the 5% level

For each academic year, the correlations are very low and not statistically significant. There was virtually no relationship between the two variables. The low correlations did not change over time.

The correlations between PSD and gender are shown in Figure 35.

Figure 35: Correlations between PSD and gender at the start of Primary 1 for three academic years

	2012/13	2013/14	2014/15	Overall
Adjustment comfortable	0.10 [*]	0.06	0.05	0.07 ^{**}
Adjustment independence	0.20 ^{**}	0.13 ^{**}	0.18 ^{**}	0.17 ^{**}
Personal confidence	0.12 ^{**}	0.05	0.13 ^{**}	0.10 ^{**}
Personal concentration (self)	0.29 ^{**}	0.22 ^{**}	0.28 ^{**}	0.26 ^{**}
Personal concentration (teacher)	0.28 ^{**}	0.22 ^{**}	0.24 ^{**}	0.25 ^{**}
Personal actions	0.27 ^{**}	0.20 ^{**}	0.29 ^{**}	0.25 ^{**}
Social relationship (to adults)	0.20 ^{**}	0.15 ^{**}	0.19 ^{**}	0.18 ^{**}
Social relationship (to peers)	0.15 ^{**}	0.11 ^{**}	0.14 ^{**}	0.13 ^{**}
Social rules	0.30 ^{**}	0.24 ^{**}	0.27	0.27 ^{**}
Social cultural awareness	0.16 ^{**}	0.10 [*]	0.13 ^{**}	0.14 ^{**}
Social communication	0.13 ^{**}	0.07	0.17 ^{**}	0.12 ^{**}

**** Significant at the 1% level * significant at the 5% level**

On average girls scored higher than boys at all time points. Whilst the correlations between PSD and gender were quite low, several were statistically significant but the size of the correlations remained broadly stable over time.

Figure 36: Correlations between PSD and SIMD at the start of Primary 1 for three academic years

	2012/13	2013/14	2014/15	Overall
Adjustment comfortable	0.08 [*]	0.00	0.02	0.04
Adjustment independence	0.05	0.05	0.11 [*]	0.07 ^{**}
Personal confidence	0.09 [*]	0.03	0.06	0.06 [*]
Personal concentration (self)	0.08 [*]	0.08	0.10 [*]	0.08 ^{**}
Personal concentration (teacher)	0.10 [*]	0.06	0.12 [*]	0.09 ^{**}
Personal actions	0.05	0.02	0.10 [*]	0.05 [*]
Social relationship (to adults)	0.14 ^{**}	0.02	0.15 ^{**}	0.10 ^{**}
Social relationship (to peers)	0.05	0.00	0.09 [*]	0.05
Social rules	0.10 ^{**}	0.02	0.02	0.05
Social cultural awareness	0.15 ^{**}	0.15 ^{**}	0.14 ^{**}	0.15 ^{**}
Social communication	0.09 [*]	0.10 [*]	0.16 ^{**}	0.11 ^{**}

**** Significant at the 1% level * significant at the 5% level**

Figure 36 shows the correlation between PSD and SIMD quintiles and was noted earlier when the data from 2012/13 was examined: the scores of children from the most affluent areas were significantly higher than those of children from the most deprived areas on several of the scales. Although many of the correlations between PSD and deprivation at the start of the academic year are statistically significant they are low, and the size of these correlations remained stable over time.

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Appendix A

Description of method to establish a representative sample of PIPS data for Scotland and a stable cohort for trend analysis

Representativeness of the 2012/13 Scottish cohort

Those schools using PIPS completed background data for each pupil within the assessment when they started school in Primary 1 aged between four and a half and five and a half. This included home postcode and Scottish Candidate Number (SCN). Either of these measures can be used to allocate a pupil to one of the deciles linked to the Scottish Index of Multiple Deprivation (SIMD). However, the assessment can be carried out without these details being completed and for the assessments administered in the 2012/13 academic year, the following information was available:

Number of pupils assessed: 20,775

Number of valid pupil postcodes: 6,519

Number of valid Scottish candidate IDs: 9,991

Number of pupils with either a valid postcode or SCID or both: 12,123

Figure 1 shows the distribution of pupils in Primary 1 by Scottish Index of Multiple Deprivation (SIMD 2012) decile from data supplied by the Scottish Government Educational Analytical Services Division. 335 pupils with unknown data zone are not included.

Figure A-1: Number of pupils in each decile in Primary 1 in 2012 (Population 56,349)

Decile	1	2	3	4	5	6	7	8	9	10	Total
Number	6,841	6,146	5,568	5,593	5,456	5,417	5,736	5,567	5,440	4,585	56,349
Proportion	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08	

This distribution can be compared with the distribution of pupils in the PIPS dataset based only on postcode information.

Figure A-2: Number of pupils in each decile from PIPS in 2012 based on postcodes (Sample 6,519)

Decile	1	2	3	4	5	6	7	8	9	10	Total
Number	632	578	706	729	599	687	737	734	683	434	6,519
Proportion	0.10	0.09	0.11	0.11	0.09	0.11	0.11	0.11	0.11	0.07	

The distribution of the number of pupils in the PIPS data set for whom home postcodes were available was fairly even across the deciles. The proportions were close to the full dataset with slightly fewer than expected for some groups (Deciles 1, 2 and 10).

Figure A-3: Number of pupils in each decile from PIPS in 2012 based on SCNs (Sample 9,911)

Decile	1	2	3	4	5	6	7	8	9	10	Total
Number	1,015	1,227	1,064	1,194	1,024	914	911	901	1,136	525	9,911
Proportion	0.10	0.12	0.11	0.12	0.10	0.09	0.09	0.09	0.12	0.05	

The distribution of the number of pupils in the PIPS data set for whom SCNs were available was also fairly even across the deciles. The proportions were close to the full dataset with slightly fewer than expected for some groups (deciles 1, 6, 7 and 10).

For 4,275 pupils, deciles were available which were derived from a postcode and SCN. The vast majority of these deciles were identical but in some cases they were not. The two sets of deciles were combined and, where there was conflict, the decile derived from the SCN was preferred. The resultant deciles derived from both postcodes and SCN are shown below in Figure 4.

Figure A-4: Number of pupils in each decile from PIPS in 2012 based on SCNs and postcodes (Sample 12,123)

Decile	1	2	3	4	5	6	7	8	9	10	Total
Number	1,147	1,372	1,264	1,437	1,240	1,170	1,222	1,189	1,373	709	12,123
Proportion	0.10	0.11	0.10	0.12	0.10	0.10	0.10	0.10	0.11	0.06	

A proportional random sample of pupils in each decile from PIPS data was selected to give a representative sample of the National Dataset as supplied by the Scottish Government's Education Analytical Services. This is reported in Figure 5. This sample was used for further investigation.

Figure A-5: Number of pupils in each decile in Primary 1 in PIPS sample Scotland 2012 matched to National Distribution (Sample 6,627)

Decile	1	2	3	4	5	6	7	8	9	10	Total
Number	788	722	656	656	656	656	656	656	656	525	6,627
Proportion	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08	

Appendix B

Personal and social development scales

Adjustment – Comfortable

1. Upset on separation from carer at the start of the session. Not at ease during the day. Does not cope easily with transitions between activities or locations within the school setting.
2. Sometimes upset on separation from carer at the start of the session. Fairly settled during the day. Occasionally finds transitions a problem.
3. Rarely upset on separation from carer at the start of the session. Copes well with transitions between activities or locations within the school. Fairly settled during the day.
4. Never upset on separation from carer at the start of the session. Comfortable for most of the time during the session. Has no difficulty coping with transitions.
5. Never upset upon separation from carer at the start of the session. Very comfortable, never ill at ease during the session. Has no difficulty coping with transitions between activities or locations.

Adjustment – Independence

1. Dependent on adults or another child for guidance and support for much of the time. Generally needs help with clothing and personal activities (coat, toilet, etc.).
2. Some dependence on adults or other children. Needs help with some clothing and personal activities (coat, toilet, etc.).
3. Independence of others for most of the time but still needs occasional support. Can cope with some clothing and personal activities, but not all (e.g. can put on coat but is unable to fasten it).
4. Independence of others for most of the time but still needs occasional support. Copes well with most clothing and personal activities.
5. Independence. Seeks assistance only when special help is required. Can put on and fasten coat, go to the toilet, etc.

Personal – Confidence

1. Very hesitant. Does not join in group activities and rarely talks.
2. Fairly hesitant. Reluctant to participate in group activities or talk.
3. Will join in group activities or talks when prompted.
4. Quite confident. Keen to join in group activities or talk within the school setting.
5. Very confident. Keen to participate in group activities within the school.

Personal – Concentration (Self-directed activities)

1. Finds it extremely difficult to concentrate. Very rarely settles to one thing and very easily distracted.
2. Short concentration span. Finds it difficult to settle down to one thing. Easily distracted.
3. Able to settle to a task and concentrate for a sustained period. May be distracted.
4. Attends quite well. Able to maintain concentration and is not disturbed by mild distractions.
5. Can focus attention, even in the face of competing activities. Has been seen to concentrate for a long period (e.g. 15 minutes).

Personal – Concentration (Teacher-directed activities)

1. Finds it extremely difficult to concentrate. Very rarely settles to one thing and very easily distracted.
2. Short concentration span. Finds it difficult to settle down to one thing. Easily distracted.
3. Able to settle to a task and concentrate for a sustained period. May be distracted.
4. Attends quite well. Able to maintain concentration and is not disturbed by mild distractions.
5. Can focus attention, even in the face of competing activities. Has been seen to concentrate for a long period (e.g. 15 minutes).

Personal – Actions

1. Acts impulsively without any consideration for the well-being of themselves and others. Demonstrates inappropriate behaviour in all situations. Unable to cope with changes in routine.

2. Occasionally considers the well-being of themselves and others before acting, but still exhibits frequent impulsive behaviour. Will interact appropriately with others when prompted, sharing and taking turns.
3. On about half of all occasions, considers the well-being of themselves and others before acting. Sometimes interacts appropriately with others but still needs frequent prompts. Copes with changes in routine reasonably well but sometimes gets over-excited.
4. Frequently considers the well-being of themselves and others before acting. Usually interacts appropriately with others without being prompted to do so. Copes quite well with changes in routine.
5. Almost always considers the well-being of themselves and others before acting. Unless severely provoked, always interacts appropriately with others without being prompted to do so. Responds positively to changes in routine.

Social – Relationships with peers

1. Finds it difficult to communicate with other children and make friends. Seems to take no account of others and is frequently inconsiderate.
2. Often has difficulty communicating with other children and making friends.
3. Communicates quite easily with other children and able to form friendships. Takes notice of the feelings of others when they become very obvious.
4. Communicates quite easily with other children and readily forms friendships. Takes notice of the feelings of others.
5. Communicates very easily with other children and readily forms friendships. Is aware of others and responds to their needs. Sensitive.

Social – Relationships with adults

1. Finds it difficult to communicate with adults. Does not approach adults or speak to them. Inappropriate behaviour whilst interacting with adults.
2. Often has difficulty communicating with adults. Reluctant to approach adults or speak to them. Usually interacts appropriately with adults.
3. Communicates with adults but some difficulty. Will approach adults and speak to them. Rarely demonstrates inappropriate behaviour whilst interacting with adults.
4. Confident approaching adults when necessary. Relates well to adults, and with appropriate behaviour.
5. Confident approaching adults when necessary. Relates easily to adults, and with appropriate behaviour. Speaking to adults is natural and easily understood.

Social – Rules

1. Takes no notice of rules. Distracts others and interrupts activities.
2. Takes little notice of rules. Can distract others and interrupt activities.
3. Sometimes ignores rules. May distract others on occasion.
4. Usually obeys rules and rarely distracts others.
5. Always obeys rules and never distracts others.

Social – Cultural awareness

1. Shows an awareness of the routines in their home environment. For example, through role-play in the 'home corner'.
2. Demonstrates an understanding of being a member of a family/household by talking about relationships and experiences with parents/siblings and other relatives.
3. Is aware that they are a member of a wider community within their local neighbourhood and pre-school setting. Talks about experiences relating to those environments.
4. Recognises that the way of life of others may be different from their own. Takes pride in their own achievements.
5. Is aware of, and respects the way of life of others. Understands that their own way of life should be respected by other children and adults.

Social – Communication

1. Communicates with others using single words, gestures and facial expressions.
2. Speaks using simple statements. Uses intonation to ask questions rather than grammatically correct language.
3. Begins to combine statements to present a coherent argument or explanation. Spoken sentences are generally a combination of ideas and not usually grammatically correct.
4. Asks simple questions. Spoken sentences are sometimes grammatically correct.
5. Speaks fluently and coherently. Speech is generally but not always grammatically correct. Listens attentively to the views of others and responds appropriately, taking turns in the conversation.

Appendix C

Item maps at the start of Primary 1

Figure C-1: Item map of the full PIPS cognitive development scale

```
INPUT: 6627 PERSON 166 ITEM REPORTED: 6623 PERSON 166 ITEM 336 CATS WINSTEPS 3.90.0

MEASURE PERSON - MAP - ITEM
<more>|<rare>
7 + Sums B_42-17
  |
  | M or L_21 more than 32
6 +
  | Sums B_ quarter of 8
  | M or L_8 more than 13
  |
5 +T Sums B_105+302 Sums B_15+21
  | Sums B_ twice 3 doubled
  | M or L_6 less than 15 Sums B_9-6
  |
4 + M or L_10 less than 25 Sums B_ half of 6 Sums B_15-4 Sums B_4+11 Walking to School
  |
  | Sentences 1 Sums B_7+3
  | M or L_3 less than 7 Num_3dig1 Num_3dig2 yacht Story 2
3 + Cats long passage M or L_3 more than 8 Num_3dig3Story 1
  | cosmetics Sentences 4 Sums B_12p orange coin
  |S Sentences 2
  | M or L_2 more than 6 Num_2dig1 W_ball W_tree
2 + Sentences 3
  | IAR_full Num_2dig2 Sentences 6 W_flower
  | Num_2dig3 Sentences 7 Sums A_rockets W_dog W_duck
  | IAR_capital Num_3dig4 Num_3dig5 W_car W_cat W_house W_rabbit
1 + Let_D Let_H Let_Q W_butterfly
  | IAR_sentence Let_J Let_Y Num_teen1 Num_teen2 Num_teen3
  | IAR_start Sums B_ half the bikes
  | Let_B Let_G Let_K Let_V Let_u M or L_1 >5 microscope Rep_observatory Sums A_ice creams Sums A_pips W_Writing
0 +M Let_A Let_F Let_c Let_w Sums A_puppies
  | IAR_sentence Let_L Let_e Let_t Let_z jewellery padlock saxophone Rep_juxtapose Rhy_dish Rhy_mouse Sums A_rabbits
  | Let_m Let_n Let_o Let_r toadstool Rhy_bin Rhy_pan Sentences 5 Sums A_bikes
  | Rep_frigglejang Rep_mantle Rhy_drum Rhy_hat Rhy_toes Sh_hexagon Sums B_5p apple coins
-1 + IAR_word Let_Name Let_r Let_x Num_9 cash Rhy_cherries Sums B_ three quarter circle
  | IAM_least IAR_Leter Let_i Num_6 pigeon Rep_riotous Rhy_sun
  | Count_fish here Num_7 Num_8
  | Let_p bowl violin Sums A_cars
-2 + IAM_shortest Let_S pan Rep_denalty Rep_enterprising
  | Count_fish there IAR_writing Num_0 Sh_square Sums A_balls
  |S Count_apples there Num_3 Num_4 knife Sh_triangle
  | Count_apples here Num_2 Num_5 cherries windmill Rep_stop
-3 + Num_1 fork wasp
  | IAM_most IAR_someone
  |
  | IAR_someone cupboard Sh_circle
-4 + IAM_more IAM_tallest
  | IAM_smallest butterfly carrots kite Sh_star
  |
  | IAM_biggest turtle
-5 +T
  | castle
  |
  |
-6 +
  |
  |<less>|<freq>
EACH "#" IS 55: EACH "." IS 1 TO 54
```

Figure C-2: Item map of the early mathematics scale

INPUT: 6627 PERSON 166 ITEM REPORTED: 6623 PERSON 65 ITEM 130 CATS WINSTEPS 3.90.0

```

MEASURE      PERSON - MAP - ITEM
              <more>|<rare>
9             . +
              | Sums B_ quarter of 8
              |
8             . + M or L_21 more than 32
              . |T Sums B_ twice 3 doubled
              . |
7             . +
              | Sums B_15+21
              | M or L_8 more than 13
6             . +
              . |
              | Sums B_15-4 Sums B_9-6
5             . + M or L_10 less than 25 M or L_6 less than 15
              . | Sums B_ half of 6 Sums B_4+11
              . |
4             . +
              . |S Num_3dig1 Num_3dig2 Num_3dig3 Sums B_ 12p orange coin
              . | Sums B_7+3
3             . T+ M or L_3 less than 7 M or L_3 more than 8
              .# |
              .# |
2             .## + M or L_2 more than 6 Num_2dig1 Num_3dig4 Num_3dig5
              .### | Num_2dig2
              .#### S| Num_2dig3 Sums A_rockets
1             .##### +
              .##### |
              .##### | Num_teen1 Num_teen2 Num_teen3
0             .##### +M Sums B_ half the bikes
              .##### M| M or L_1 more than 5 Sums A_ice creams Sums A_pips
              .##### | Sums A_puppies
-1            .##### + Sums A_bikes Sums A_rabbits
              .##### | Sh_hexagon Sums B_5p apple coins
              .##### | Num_9 Sums B_ three quarter circle
-2            .#### S+ IAM_least Num_6 Num_8
              .### | Count_fish here Num_7
              .## | Sums A_cars
-3            .## + Count_fish there IAM_shortest Num_0
              .# T| Count_apples there Sh_square Sums A_balls
              . |S Num_2 Num_3 Num_4 Num_5 Sh_triangle
-4            . + Count_apples here Num_1
              . | IAM_most
              . |
-5            . + IAM_more IAM_tallest Sh_circle
              . |
              . | IAM_smallest Sh_star
-6            . + IAM_biggest
              . |
              |
-7            . +
              |
              |T
-8            . +
              <less>|<freq>
EACH "##" IS 51: EACH "." IS 1 TO 50

```

Figure C-3: Item map of the early reading scale

```

INPUT: 6627 PERSON 166 ITEM REPORTED: 6623 PERSON 68 ITEM 136 CATS WINSTEPS 3.90.0
-----
MEASURE PERSON - MAP - ITEM
        <more>|<rare>
6          . +
          . |
          . |
          . |
5          . +
          . |
          . |
          . |
          . | Sentences 1
4          . +
          . | Story 2
          . |
          . | Story 1
          . |T Sentences 2
3          . +
          .# |
          .# |T
          .## | W_ball W_tree
          .## |
2          .## + W_flower
          .### |
          .#### |S IAR_full W_duck
          .##### S| W_car W_dog
          .##### | IAR_capital Lett_D Lett_Q W_butterfly W_cat W_house
1          .##### + Lett_H Lett_J Lett_Y W_rabbit
          .##### |
          .##### | IAR_sentence Lett_G Lett_V Lett_u
          .##### |
          .##### M| IAR_start Lett_B Lett_w Rep_observatory
0          .##### +M Lett_A Lett_F Lett_K Lett_c
          .##### | Lett_L Lett_e
          .##### | IAR_sentence Lett_n Lett_r Lett_t Lett_z Rep_juxtapose Rhy_dish Rhy_mouse
          .##### | Lett_m Lett_o Rhy_bin Rhy_pan
          .##### | Rep_frigglejang
-1          .##### S+ Lett_i Rep_mantle Rhy_drum Rhy_hat Rhy_toes
          .##### | IAR_word Lett_Name Letter Lett_x Rhy_cherries
          .### | IAR_Letter Rhy_sun
          .### |S Lett_p Rep_riotous
          .## |
-2          .# + Rep_denalty Rep_enterprising
          .# T| Lett_S
          . |
          . | IAR_writing
          . |
-3          . + Rep_stop
          . |T
          . | IAR_someone
          . |
-4          . + IAR_someone
          . |
          . |
          . |
-5          . +
          . +
          <less>|<freq>
EACH "#" IS 39: EACH "." IS 1 TO 38

```

Figure C-4: Item map of the picture vocabulary scale

INPUT: 6627 PERSON 166 ITEM REPORTED: 6623 PERSON 23 ITEM 46 CATS WINSTEPS 3.90.0

```

-----
MEASURE    PERSON - MAP - ITEM
           <more>|<rare>
7          . +
           |
           |
           |
6          .## + PV_cosmetics
           | PV_yacht
           T|
           |T
           |
5          .##### +
           |
           |
           |
4          .##### S+
           |
           |
           |
3          .##### +
           | PV_microscope
           |S PV_jewellery PV_saxophone
           .##### M|
           .##### |
           .# +
           .##### |
           .## | PV_padlock PV_toadstool
           .### | PV_cash
           |
1          .##### +
           |
           .### S| PV_pigeon
           |
           .## | PV_violin
0          . +M PV_bowl
           .# |
           | PV_pan
           . |
           . |
           . T+ PV_windmill
           . | PV_cherries PV_knife PV_wasp
           . |
           . |
           . | PV_fork
-2          +
           |
           |
           . |S PV_butterfly PV_cupboard
           | PV_kite
-3          + PV_turtle
           |
           |
           . | PV_carrots
           | PV_castle
-4          . +
           |
           <less>|<freq>
EACH "##" IS 85: EACH "." IS 1 TO 84

```

Figure C-5: Item map of the phonological awareness scale

INPUT: 6627 PERSON 166 ITEM REPORTED: 6623 PERSON 17 ITEM 34 CATS WINSTEPS 3.90.0

```

MEASURE      PERSON - MAP - ITEM
              <more>|<rare>
4  .##### +
    |
    |
    |
    |
    T|
    |
3  .##### +
    |
    |
    |
    |
    |
    .##### S|
    . |
2  .##### +
    |
    |
    |
    . |T
    . |
    .##### | Rep_observatory
    .## |
    .# |
1  .##### M+
    .### |S
    .#### | Rhy_dish Rhy_pan
    .## | Rep_juxtapose Rhy_mouse
    .### | Rhy_bin
    .### |
    .### |
    .### | Rep_frigglejang Rep_mantle Rhy_drum Rhy_toes
0  .# |M Rhy_hat
    .## S|
    .# | Rhy_cherries Rhy_sun
    .### |
    . | Rep_riotous
    . |
    .# |
    . |S
-1  . + Rep_denalty Rep_enterprising
    . |
    . T|
    . |
    . |
    # |T
    . |
    . |
-2  . +
    .# | Rep_stop
    . |
    . |
    . |
    . |
-3  . +
    <less>|<freq>
EACH "#" IS 56; EACH "." IS 1 TO 55

```

Appendix D

Supplementary information

Figure D-1: Picture vocabulary scores for Scotland at the start of Primary 1 over three academic years

	2012/13	2013/14	2014/15	Combined
n (%)	6526 (100)	6526 (100)	6526 (100)	19578 (100)
Mean (SD)	0.00 (0.98)	-0.05 (1.00)	-0.08 (0.99)	-0.05 (0.99)
Median	-0.10	-0.10	-0.10	-0.10
(min, max)	(-2.69, 2.81)	(-2.69, 2.81)	(-2.69, 2.81)	(-2.69, 2.81)

The picture vocabulary scores were normalised. At the start of Primary 1, they declined very slightly over the three academic years.

Figure D-2: Phonological awareness scores for Scotland at the start of Primary 1 over three academic years

	2012/13	2013/14	2014/15	Combined
n (%)	6526 (100)	6526 (100)	6526 (100)	19578 (100)
Mean (SD)	-0.01 (0.97)	-0.11 (0.96)	-0.14 (0.99)	-0.08 (1.02)
Median	-0.03	-0.03	-0.03	-0.07
(min, max)	(-2.65, 1.71)	(-2.65, 1.71)	(-2.65, 1.71)	(-3.13, 3.73)

At the start of Primary 1, phonological awareness declined slightly over time.

Figure D-3: Months difference in end of Primary 1 scores between academic years

	2013/14 compared with 2012/13	2014/15 compared with 2013/14
Total	-0.06*	-1.03**
Early Reading	-0.60**	-0.68**
Early Mathematics	0.07	0.19

** Significant at the 1% level * significant at the 5% level

At the end of Primary 1, the total scores declined over time. Looking in more detail, early reading declined more than early mathematics. More information and interpretation in relation to progress is included in the main body of the report.

Appendix E

Characteristics of children who are relatively old for Primary 1

Analysis was undertaken in which children were put into age categories corresponding to three-month increments from four years six months to five years nine months and then one category for children older than that. Figure E-1 gives details of numbers, sex, mean age and mean SIMD quintiles.

Figure E-1: Age categories and background data

Age category			Sex (male=0 Female =1)	SIMD Quintiles (Scores ranged from 1 representing the most deprived to 5)	Age at start of Primary 1
Lowest 4.75	-	Mean	.52	2.82	4.62
		N	1420	1429	1433
		Std.	.50	1.39	0.08
		Deviation			
4.75 - 5		Mean	.52	2.88	4.88
		N	1666	1676	1677
		Std.	.50	1.42	0.07
		Deviation			
5 - 5.25		Mean	.50	2.92	5.12
		N	1672	1680	1686
		Std.	.50	1.42	0.07
		Deviation			
5.25 - 5.5		Mean	.49	2.94	5.36
		N	1426	1430	1434
		Std.	.50	1.42	0.07
		Deviation			
5.5 - 5.75		Mean	.36	3.12	5.58
		N	321	319	321
		Std.	.482	1.48	0.06
		Deviation			
5.75 Highest	-	Mean	.37	2.94	5.94
		N	63	63	63
		Std.	.485	1.52	0.17
		Deviation			
Total		Mean	.50	2.90	5.03
		N	6568	6597	6614
		Std.	.50	1.42	0.31
		Deviation			

Figure E-1 indicates that the pupils who were older than expected in Primary one (over five and a half years) were more likely to be boys (64%) and slightly more likely to come from less deprived homes.

Figure E-2: Mean total scores at the start of Primary 1 by age category

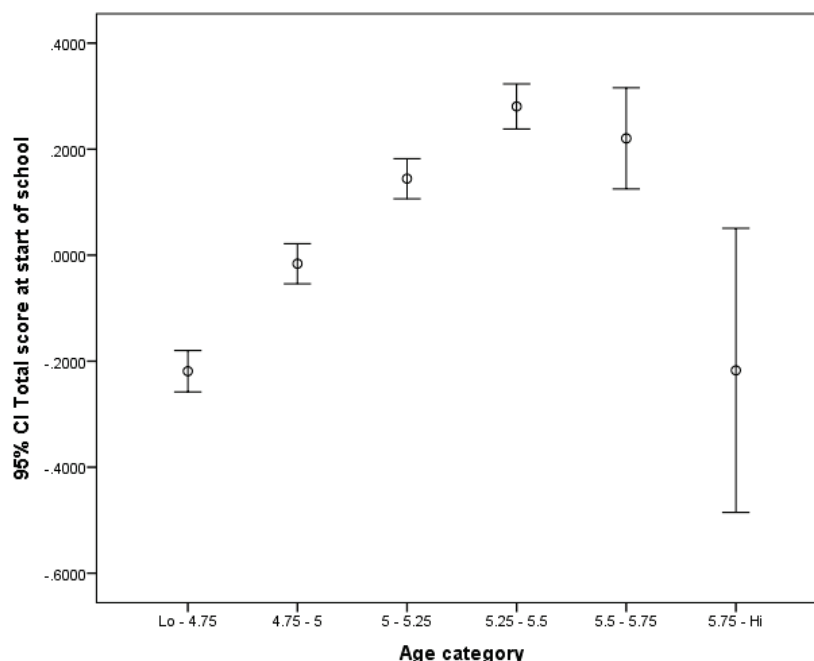


Figure E-2 shows a clear steady rise in total score until age five a half when the rise falls away. The older children had, on average, lower cognitive scores than expected. This is confirmed and quantified for each measure in the figure below.

Figure E-3: Months equivalent differing from expectation for older children.¹⁴

	5.5 to 5.75 years	>5.75 years
Total	-2.8*	-17.0**
Early Reading	-3.0*	-12.6**
Early Mathematics	-2.4*	-17.9**
Picture Vocabulary	-3.4*	-19.5**
Phonological Awareness	-3.9**	-22.6**

** Significant at the 1% level * significant at the 5% level

PSD for older children

The number of children rated in the older categories was small but the difference between their ratings on the scales and the average scores are shown in Figure E-4.

¹⁴ All of the data were used to regress each standardised score against age and the residuals were retained. These residuals (differences from expected score for age) were compared to zero in one sample t-tests for the two relevant age categories.

Figure E-4: PSD for older children

	5.5 to 5.75 years	N	>5.75 years	N
Adjustment comfortable	-0.29*	31	-0.64*	7
Adjustment independence	-0.19	31	-0.61	7
Personal confidence	-0.09	31	-0.33	7
Personal concentration (self-directed)	-0.19	31	-0.76*	7
Personal concentration (teacher-directed)	-0.22	31	-0.51	7
Personal actions	-0.31	31	-0.76*	7
Social relationship (to adults)	-0.12	31	-0.70*	7
Social relationship (to peers)	-0.24*	31	-1.02**	7
Social rules	-0.26	31	-0.65*	7
Social cultural awareness	-0.07	31	-1.15**	7
Social communication	-0.19	31	-1.29**	7

**** Significant at the 1% level * significant at the 5% level**

Although the samples are small the data do fit a pattern in which the entry to Primary 1 of children whose PSD is delayed tends to be deferred by one year.

A natural question to ask concerns the long term impact of deferring children's entry to Primary 1 for a year. The analysis in this report cannot give a satisfactory answer. Previous work in the USA looking at so called "red shirting" has suggested no advantage to keeping children back for a year at the start of school and we know that once children start school, making them repeat a grade is generally detrimental. We also know, from our analyses of data in England, that delaying start to Christmas or Easter does not bring advantages. But this is different. There is clearly a tradition in Scotland for a small number of children with delayed cognitive development and PSD to be kept back for a full year. It might be valuable to examine this as part of a different study.

Appendix F

Does the link between deprivation and progress vary across schools or are some schools better at improving equity?

For this investigation it was important to include as much data as possible to increase the power of the analyses which was carried out using multi-level models. All of the data which was available in 2014/15 was used, providing pupils had scores at the start and end of Primary 1. Information was used from 987 schools and 24,473 pupils.

Pupils were nested in schools and three models were generated for each outcome. The null model simply partitioned the variance of the end scores between schools and pupils. The second introduced three variables: the start of Primary 1 score on the relevant variable, deprivation (decile centred on the grand mean) and sex (dummy variable identifying girls). In the third (Model 2) the deprivation variable was allowed to vary across schools. The results with total score as the outcome are shown below.

Figure F-1: Multi-level models for the total score

		Null	Model 1	Model 2
Fixed	Constant	2.23 (0.01)	2.23 (0.01)	2.23 (0.01)
	Prior score		0.544 (0.003)	0.564 (0.003)
	Deprivation: decile, centered on grand mean		0.005 (0.001)	0.005 (0.001)
	Female		-0.002 (0.006)	-0.002 (0.006)
	School variance	0.072 (0.005)	0.063 (0.004)	0.06292 (0.00360)
Random	Deprivation variance			0.00014 (0.00008)
	Covariance school/deprivation			-0.00036 (0.00040)
	Pupil variance	0.480 (0.004)	0.200 (0.002)	0.200 (0.002)

Standard errors are given in parentheses

The Null model indicates that 13% of the variance in the total score was associated with school membership and 87% resided with pupils. Introducing the total score at the start of the year, deprivation and sex reduced the school level variance by 12% and the pupil level variance by 58% in Model 1. Schools varied and a large proportion of the variance (31%) was located with the schools. This can be interpreted as evidence that the progress made in schools varied considerable. The prior score (start of Primary 1 score) was a strong significant predictor, responsible for the reduction in the school level and pupil level variances. Deprivation was a weak significant predictor in that when it was added to the model after the Primary 1 score the variances at the school and pupil level remained the same. Sex was not significant. One point to note here is that the prior attainment score, in a sense,

already has information about deprivation and sex and this may explain why the other two variables add so little.

Model 2 allowed deprivation to vary across school but the variation was not significant ($p > .05$). Figure F-2 shows the school intercept residuals and school deprivation slope residuals. Both include standard errors. In other words the first figure below shows how the progress in each school differ from the average – as in Figure 24 - and the second figure shows how the link to deprivation differs from the average for each school.

Figure F-2: School residuals for intercepts and slopes

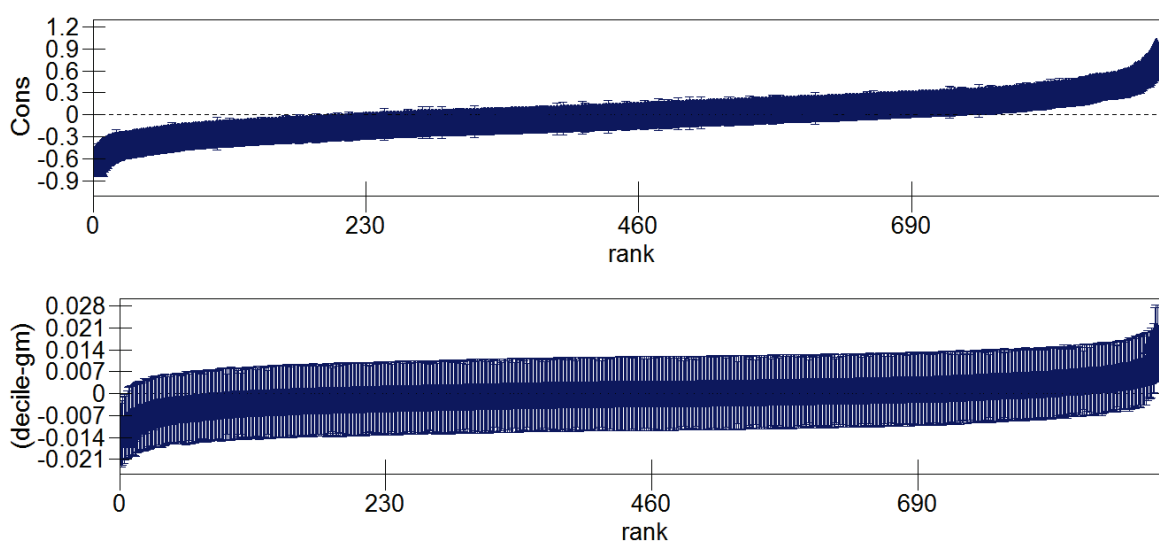


Figure F-2 supports the conclusions drawn from the tables. There were large differences between the mean progress made across schools but there was no evidence of differential impact on equity. This means that although schools made a big difference to academic progress this progress varied from school to school. Further, schools generally had little impact on the educational gap and this was the same across schools.

Parallel models were run for maths and reading. Again there was no significant difference in the link between progress and deprivation across schools.



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